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ABSTRACT

This guide, which is designed for use with student and teacher guides to a 10-unit secondary-level course in natural resources, contains a series of student supplements and advanced assignment and job sheets that provide students with additional opportunities to explore the following areas of natural resources and conservation education: outdoor safety and first aid, natural resources and conservation, water resource management, land management, air resource management, energy resources, forestry, wildlife management, wildlife habitats, and outdoor recreation. Among the topics covered in the student supplements and the advanced assignment/job sheets are the following: interpreting material safety data sheets, making/using compost, tracing routes of recyclable products, analyzing current reports concerning natural resources and conservation conflict areas, calculating maximum contaminant levels and lifetime health advisories, drawing conclusions from water measurements, identifying ways of reducing water consumption, analyzing fertilizers, determining sites' suitability for septic systems, developing weather forecasts, collecting/reporting results from air monitoring equipment, building/testing solar collectors and methane generators, projecting economic returns form forestry plots, developing wildlife food plots and habitats, and developing historical presentations for visitors to recreation areas. (MN)

ED 387 607

INTRODUCTION TO

Natural Resources

Advanced Applications

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Introduction to Natural Resources:

Advanced Applications

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Outdoor Safety and First Aid
Advanced Applications
Unit 1

Student Supplement 1A—Guidelines for Interpreting Material Safety Data Sheets

Living in the modern world, you probably are aware that the use of chemicals offers convenience and progress at home and work and outdoors. Naturally, you want to avoid dangerous overexposure to chemicals, especially on the job. Such overexposure is possible no matter where you work, even in an office or light industry.

Your company's hazard communications (HazCom) program was created to protect your health and safety. Three important elements are at the heart of your HazCom program: warning labels on containers, training on the safe use and handling of chemicals, and material safety data sheets (MSDSs).

What is on a MSDS

MSDSs are printed pages that give you all the critical information you need about how to use, transport, and store chemicals in order to protect yourself, as well as what to do in case of emergencies and overexposure. Information on MSDSs includes:

- The chemical's name or names
- Name, address, and phone number of the manufacturer
- List of the chemical's ingredients
- Permissible exposure limits (PEL) or threshold limit value (TLV)
- What conditions or other substances will cause the chemical to catch fire, explode, melt, or turn into dangerous gases
- How the chemical usually looks and smells
- How to put out a fire involving the chemical
- What to do if the chemical spills or leaks
- How to prevent dangerous exposure
- Health hazards such as skin irritant or cancer-causing agent
- Symptoms of overexposure
- What to do if you are overexposed
- When the MSDS was prepared

The information for each chemical's MSDS is put together by the manufacturer or distributor for that chemical. The sheets often look different from each other, but they still provide the same information. The law requires your employer to keep MSDSs up to date and to send the MSDS to your doctor or designated representative if you request it.

Where the MSDS is kept

MSDSs must be readily accessible to employees—a posted sign may tell you where, and you can also find out by reading your company's written HazCom program. If you are not sure where to find MSDSs, your supervisor or your company's HazCom contact will make them available to you. It is the law.

Student Supplement 1A

When to read a MSDS

You should always read the MSDS *before* you begin a job using a chemical. Even if you have used the chemical before, the manufacturer may have changed its formula, which may change the steps you should take to protect yourself. Taking proper precautions listed on the MSDS, such as wearing a respirator, can prevent serious long-term illnesses.

If you do not understand something on the MSDS, or have questions about your company's HazCom program, ask your supervisor or company contact. Your company knows that HazCom works best if you are fully informed and involved.

How to read a MSDS

The material safety data sheet, or MSDS, is written information that can help protect you from overexposure to chemicals you find on the job. The MSDS is part of your company's hazard communications program. Each company can design its own MSDS form, and the sections may be in a different order. But, the basic kinds of information on any MSDS will be the same.

Chemical name (see Figure 1). Lists the identity of the substance (the name on the label), date the MSDS was prepared, the name and address of the manufacturer, and usually a phone number for emergencies and more information.

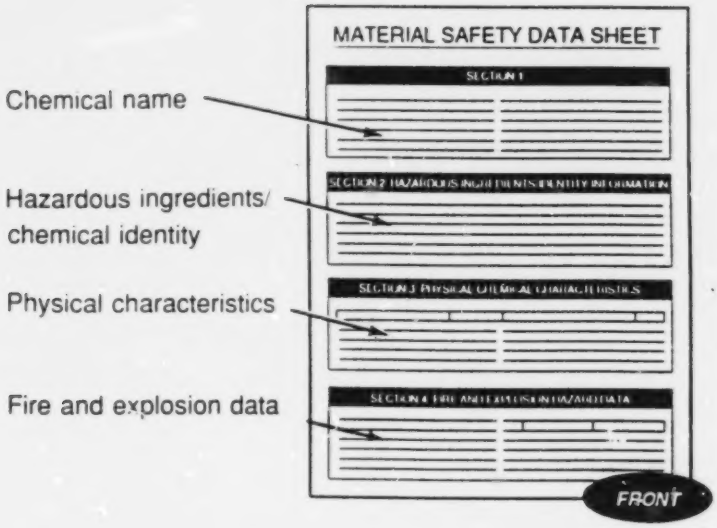
Hazardous ingredients/chemical identity (see Figure 1). Includes names of substances in the chemical that might be dangerous, and lists safety exposure limits such as permissible exposure limit or PEL (set by OSHA) or the threshold value limit or TVL. Also lists common names for the chemical.

Physical characteristics (see Figure 1). Describes many physical qualities of the chemical, and lets you know what is usual or safe. For example, how the chemical looks and smells; boiling and melting temperatures (important in case a chemical might become a gas you could breathe); evaporation rate (known as *percent volatile*); how easily the chemical dissolves; and how heavy it is (this tells you if it will sink, float, or dissolve in water).

Fire and explosion data (see Figure 1). Tells you the lowest temperature at which the chemical could catch fire (flash point). Lets you know if it is flammable (catches fire below 100°F) or combustible (catches fire above 100°F). Lists the best way to put out a fire involving that chemical.

Student Supplement 1A

Figure 1



Reactivity (see Figure 2). Describes what happens if this chemical comes in contact with air, water, or other chemicals. Describes conditions (like heat) or materials (like water) that can cause the chemical to react by burning, exploding, or releasing dangerous vapors. The chemical is called "incompatible" or "unstable" with these conditions or substances.

Health hazards (see Figure 2). Lists ways the chemical might enter your body, like splashing on your skin or being breathed in as vapor, as well as possible symptoms of overexposure. Lets you know if overexposure might make existing medical conditions worse, and describes emergency first-aid procedures.

Usage, handling, and storage (see Figure 2). Describes how to clean up an accidental spill, leak, or release, including special procedures. Tells you how to handle, store, and dispose of chemicals safely. Remember, if there is an accident, notify your supervisor immediately. Take care of it yourself only if you are trained to do so and are wearing the proper equipment.

Special protection and precautions (see Figure 2). Explains special personal protective equipment (PPE) and other equipment to use when working with the chemical, special procedures, extra health or safety information, signs that should be posted, and other information not covered in other sections.

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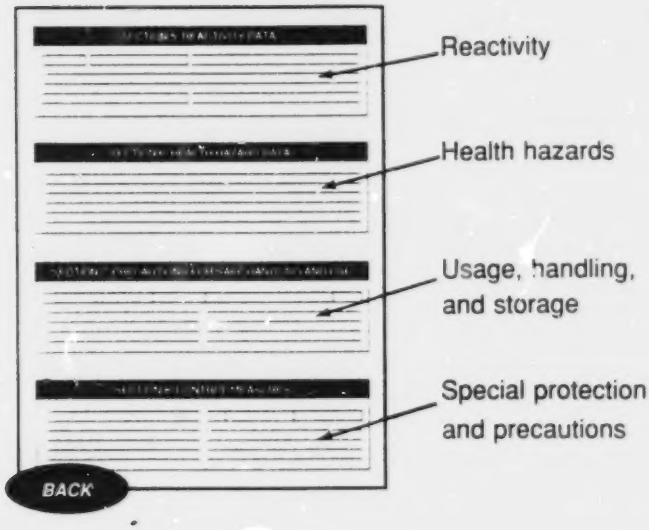
Figure 2



Terms and abbreviations used on MSDSs

The following terms and abbreviations will help you interpret material safety data sheets.

- **TLV**—Threshold limit value; a time-weighted average concentration *under which* most people can work consistently for 8 hours a day, day after day with no harmful effects
- **Ceiling**—Uppermost limit
- **ACGIH**—American Conference of Governmental Industrial Hygienists
- **OSHA**—Occupational Safety and Health Act
- **PEL**—Permissible exposure limit; the maximum time-weighted concentration *at which* 95 percent of exposed, healthy adults suffer no adverse effects over a 40-hour week
- **ppm**—Parts per million
- **STEL**—Short-time exposure limit; a 15-minute, time-weighted average that should not be exceeded at any time during a workday. Exposures at STEL should not be longer than 15 minutes and should not be repeated more than four times a day with at least 60 minutes between exposures
- **IDLH**—Immediately dangerous to life and health; material *at* or *above* this level poses an immediate hazard to life or produces immediate, irreversible, debilitating effects

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- **LEL**—Lower explosive limit; below the flammability range (too lean to burn)
- **UEL**—Upper exposure limit; above the flammability range (too rich to burn)

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Outdoor Safety and First Aid
Advanced Applications
Unit 1

Student Supplement 2A—Sample MSDSs

Student Supplement 2A

MSDS 1

Cato Oil and Grease Co.
P.O. Box 26868
Oklahoma City, OK 73126

A SUBSIDIARY OF KERR-McGEE REFINING CORPORATION

MATERIAL SAFETY DATA SHEET

MSDS NUMBER: C-7071

EMERGENCY TELEPHONE	COMPANY	CHEMTREC
	405/424-3311	800/424-9300

I. PRODUCT IDENTIFICATION

PRODUCT	CHEMICAL NAME	
Cato Permanent Antifreeze and Summer Coolant	Ethylene Glycol	
CHEMICAL FAMILY	**FORMULA**	**CAS NUMBER**
Ethylene Glycol	Not Applicable	Mixture
NATIONAL FIRE PROTECTION ASSOCIATION HAZARD (Least - 0, Slight - 1, Moderate - 2, High - 3, Extreme - 4)	**HEALTH CODE**	**FIRE CODE** / **REACTIVITY CODE**
	1	1 / 0

II. HAZARDOUS COMPONENTS

INGREDIENT	%	OSHA LIMIT	TLV
Ethylene Glycol & Glycols	94	Not Applicable	Ceiling-50 ppm
Inhibitors	6	Ingredients are proprietary. Potential hazards have been evaluated and pertinent information has been included in Sections IV-IX.	
pH Approximately 11			

III. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT	VAPOR PRESSURE	EVAPORATION (ETHYL ETHER = 1)
>300°F	<0.1 mm Hg @68°F	Slower
PERCENT VOLATILE BY VOLUME (%)	**MOLECULAR WEIGHT**	**APPEARANCE**
Not Applicable	Not Available	Green Hygroscopic Liquid
ODOR AND THRESHOLD	**MELTING POINT**	**VAPOR DENSITY (AIR = 1)**
Not Applicable	Not Available	2.1
SPECIFIC GRAVITY (H_2O = 1)	**VISCOSITY**	**SOLUBILITY (G/100G WATER AT 20°C)**
1.1	24 Centistokes @20°C	Infinitely Soluble

MSDS 1

IV. FIRE PROTECTION INFORMATION

FLASH POINT AND METHOD	AUTOIGNITION TEMPERATURE	FLAMMABLE LIMITS % VOLUME IN AIR	LOWER	UPPER
Pensky-Martens Closed Cup 240°F	748°F	Not Available	3.2	Not App.

EXTINGUISHING MEDIA

Water spray, carbon dioxide, dry chemical, or foam.

HAZARDOUS DECOMPOSITION PRODUCTS

Incomplete combustion can yield carbon monoxide and carbon dioxide.

FIRE AND EXPLOSION HAZARDS

Not Applicable

HAZARDOUS POLYMERIZATION		STABILITY	
☐ Will Not Occur	☐ May Occur	☒ Stable	☐ Unstable

V. HEALTH INFORMATION

INHALATION

Possible effects include nasal and respiratory irritation, drowsiness, narcosis, unconsciousness.

EYE CONTACT

Possible irritation with prolonged or repeated contact.

SKIN CONTACT

Possible irritation with prolonged or repeated contact.

INGESTION

Possible effects include liver or kidney damage, drowsiness, narcosis, unconsciousness, death.

REPORTED AS POTENTIAL CARCINOGEN OR CARCINOGEN		
	☒ Not Applicable	☐ National Toxicology Program
	☐ International Agency for Research on Cancer	☐ OSHA

MSDS 1

VI. FIRST AID PROCEDURES

INHALATION

Move exposed person to fresh air. If breathing has stopped, perform artificial respiration. Get medical attention as soon as possible.

EYE CONTACT

Immediately flush eyes with water for a minimum of 15 minutes, occasionally lifting the lower and upper lids. Get medical attention if redness or irritation occurs.

SKIN CONTACT

If clothing is soaked, immediately remove clothing and wash skin with soap and water. Launder clothing before wearing.

INGESTION

Give large quantities of water, then induce vomiting immediately. Get medical attention as soon as possible. Never give anything by mouth to an unconscious person.

VII. EMPLOYEE PROTECTION

RESPIRATORY PROTECTION (UTILIZE NIOSH APPROVED RESPIRATORS. REFER TO MANUFACTURER'S PROTECTION FACTORS AND OSHA STANDARD 1910.134 AS A GUIDELINE.)

Up to 500ppm ethylene glycol, full-face supplied air respirator.
Greater than 500ppm, fire fighting, or unknown concentration, self-contained breathing apparatus with positive pressure.

PROTECTIVE CLOTHING	
	EYE: Safety glasses, chemical goggles, or face shield as appropriate for exposure.
	SKIN: For prolonged contact use rubber or neoprene gloves or other material resistant to ethylene glycol.

VENTILATION

Maintain local or dilution ventilation to keep air concentration below 500ppm ethylene glycol. Request assistance of safety and industrial hygiene personnel to determine air concentration.

MSDS 1

VIII. TRANSPORTATION AND STORAGE INFORMATION

DOT Hazardous Material ☐ Yes ☒ No

DOT SHIPPING NAME AND NUMBER	DOT HAZARD CLASS
Not Applicable	Not Applicable

STORAGE

Do not store with strong oxidizers.

IX. ENVIRONMENTAL PROTECTION

SPILLS

Notify emergency response personnel. Build dike to contain flow.
Remove free liquid, do not flush to sewer or open water.
Pick up with inert absorbent and place in closed container for disposal.

WASTE DISPOSAL

EPA Hazardous Waste ☐ Yes ☒ No	EPA WASTE CODE NUMBER	WASTE CHARACTERISTIC OR HAZARD CODE
	Not Applicable	Not Applicable

Utilize licensed waste disposal company.
Utilize permitted industrial waste disposal site.

SIGNATURE	DATE PREPARED

DISCLAIMER

The information and recommendations contained in this publication have been compiled from sources believed to be reliable and to represent the best current opinion on the subject at the time of publication. Since we cannot anticipate or control the many different conditions under which this information or our products may be used, we make no guarantee that the recommendations will be adequate for all individuals or situations. Each user of the product described herein should determine the suitability of the described product for a particular purpose and should comply with all federal and state rules and regulations concerning the described product.

Student Supplement 2A

MSDS 2

MATERIAL SAFETY DATA SHEET
Emergency Phone 1-800-424-9300

Green Light
Products: Sevin 5% Dust
EPA Registration: 869-118
Trade/Common Chemical Name: "SEVIN" BRAND 97.5% TECHNICAL
Manufacturer: Rhone-Poulenc Ag Company
Effective Date: 01/01/92

1. **INGREDIENTS:**
   Carbaryl, (1-Naphthyl N-methylcarbamate) 97.5% by wt Cas# 63-25-2

2. **PHYSICAL DATA:**
   BOILING POINT: n/a
   VAPOR PRESSURE: Less than 0.000040 mm Hg
   SOL. IN WATER: 40 ppm @ 30C
   MELTING POINT: 288F (142C)
   APPEARANCE: White to light tan solid
   ODOR: Mild phenolic odor

3. **FIRE AND EXPLOSION HAZARD DATA:**
   FLASH POINT: 380F (193C)
   METHOD USED: Cleveland Open Cup
   FLAMMABLE LIMITS: Lower: 0.02 ounces/cubic foot, Upper: Not known
   EXTINGUISHING MEDIA: Dry chemical or CO_2 for small fires; water spray or foam for large fires.
   FIRE AND EXPLOSION HAZARDS: Thermal decomposition products may be hazardous. These may include oxides of nitrogen and carbon small amounts of methyl isocyanate. Avoid dispersion of dust in air to reduce potential explosion hazard. Use electrical equipment suitable for atmospheres that may contain combustible dusts.
   FIRE-FIGHTING EQUIPMENT/PROCEDURES: Evacuate residents who are downwind of fire. Prevent unauthorized entry to fire area. Firemen should wear protective clothing and use self-contained breathing apparatus. Anyone who may have been exposed to contaminated smoke should be immediately checked for symptoms of poisoning. These should not be mistaken for heat exhaustion or smoke inhalation. Dike area to prevent runoff and contamination of water sources.

4. **REACTIVITY DATA:**
   STABILITY: Stable
   Avoid extended storage at temperatures in excess of 100F (37.8C).
   INCOMPATIBILITY(Specific materials to avoid): Alkalis, strong acids.
   HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of nitrogen and carbon and minute quantities of methyl isocyanate may be produced upon thermal decomposition.

5. **ENVIRONMENTAL AND DISPOSAL INFORMATION:**
   ACTION TO TAKE FOR SPILLS/LEAKS: Sweep or shovel spills into waste container while minimizing dust generation. Wear appropriate personal protective equipment. Do not contaminate water sources.
   DISPOSAL METHOD: Dispose of in an approved landfill or incinerator following all applicable federal, state, and local regulations.

MSDS 2

6. HEALTH HAZARD DATA:

EYES: Dusts or sprays (mists) may cause eye irritation, seen as tearing and redness.

SKIN CONTACT: Minimal irritation. Dermal LD50 rabbit: 2000 mg/kg.

SKIN ABSORPTION: Harmful if absorbed through skin. May lead to symptoms as described for ingestion.

INGESTION: May be fatal if swallowed. Oral LD50 rats: 264 mg/kg.
May lead to rapid onset of nausea, vomiting, abdominal pain, diarrhea, pinpoint pupils, blurred vision, profuse sweating, salivation, tremors, muscle twitching, and temporary paralysis. In severe poisoning respiratory depression and convulsions may occur.

INHALATION: Harmful if inhaled. Inhalation of dusts or sprays (mists) may lead to symptoms as described for ingestion. May be irritating to the respiratory tract.
LC50 (rat - 4 hr exposure): 2.50 mg/l.

SYSTEMIC & OTHER EFFECTS: Repeated overexposure may cause more severe cholinesterase inhibition with the signs and symptoms being more pronounced. Skin irritation may be aggravated in persons with existing skin lesions. Breathing of vapor, dust, or sprays (mists) may aggravate asthma and inflammatory or fibrotic pulmonary disease. Overexposure may aggravate existing chronic cardiovascular or respiratory disease leading to respiratory difficulty, pulmonary edema and cyanosis.

7. FIRST AID:

PRECAUTION: Persons attending the victim should avoid direct contact with heavily contaminated clothing and vomitus. Wear impervious gloves while decontaminating skin and hair. Remove the patient from immediate source of exposure and assure that the individual is breathing.

EYES: Hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. GET MEDICAL ATTENTION.

SKIN: Immediately wash skin with plenty of soap and water, if available, while removing contaminated clothing and shoes. Wash clothing separately before reuse.

INGESTION: If patient is conscious and alert, give 2-3 glasses of water or milk to drink. If available, give one tablespoon of syrup of ipecac to induce vomiting. Alternately, induce vomiting by touching back of throat with finger. Do not repeat the syrup of ipecac. Do not make an unconscious person vomit. GET MEDICAL ATTENTION.

INHALATION: Remove victim to fresh air. If not breathing, give artificial respiration. Administer oxygen if necessary. GET MEDICAL ATTENTION.

NOTES TO PHYSICIAN: All treatments should be based on observed signs and symptoms of distress in the patient. Overexposure to materials other than this product may have occurred.

This product contains a methyl carbamate insecticide, which is a cholinesterase inhibitor. Overexposure to this substance may cause toxic symptoms due to stimulation of the cholinergic nervous system. These effects of overexposure are spontaneously and rapidly reversible.

Specific treatment consists of parenteral atropine sulfate. Improve tissue oxygenation as much as possible before administering atropine to minimize the risk of ventricular fibrillation. Mild cases may be given 1-2 mg intramuscularly every 10 minutes until full atropinization has been achieved and repeated thereafter whenever symptoms reappear. Severe cases should be given 2-4 mg. Intravenously every 10 minutes until fully atropinized, then intramuscularly every 30-60 minutes as needed to maintain the effect for at least 12 hours. Dosages for children should be appropriately reduced. Caution should be maintained to prevent overatropinization. Complete recovery from overexposure is to be expected within 24 hours.

Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended.

To aid in confirmation of a diagnosis, urine samples should be obtained within 24 hours of exposure and immediately frozen. Analysis will be arranged by Rhone-Poulenc Ag Company.

MSDS 2

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINES(S): Carbaryl: 5 mg/m^3 air TLV-TWA (ACGIH) and PEL-TWA (OSHA)
VENTILATION: Mechanical (general) ventilation
RESPIRATORY PROTECTION: Use NIOSH/MSHA approved respirator for pesticide dust when handling spills or leaks, or when airborne concentrations exceed allowable exposure limits.
SKIN PROTECTION: Chemical-resistant gloves, full-body protective clothing, safety shower.
EYE PROTECTION: Goggles, eye bath.

9. ADDITIONAL INFORMATION:

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Do not ingest. Avoid inhaling dusts or sprays (mists). Avoid getting in eyes, on skin, or on clothing. Store unused product in original container only, in cool, dry area out of reach of children and animals. Do not store in areas where temperatures frequently exceed 100F. Do not contaminate water, food, or feed by storage or disposal.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Green Light makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Green Light's control. Therefore, users are responsible for determining whether under their own operating conditions the product is suitable for their particular use. Users assume all risks of use, handling, and disposal of product. The publication or use of, or reliance upon, information contained herein does not relate to the use of this product in combination with any other material or in any other process.

Student Supplement 2A

MSDS 3

GRACE

AMMONIUM NITRATE

IDENTIFIER (Common Name)

MATERIAL SAFETY DATA SHEET

MANUFACTURER'S NAME: W. R. Grace & Co., Ag Chem Group	EMERGENCY TELEPHONE NO: 919-763-0171
ADDRESS: 100 N. Main Street P.O. Box 277 Memphis, TN 38101	OTHER INFORMATION: 1-800-424-9300 CHEMTREC
PREPARED BY: W. R. Grace & Co., Ag Chem Group	DATE PREPARED: 9-18-85

SECTION 1 – PRODUCT IDENTIFICATION

COMMON NAME (Used on Label, Trade Name, and Synonym): Ammonium Nitrate

CHEMICAL NAME: Ammonium Nitrate — CAS NO 6484-52-2

SECTION 2 – HAZARDOUS INGREDIENTS MIXTURE ☐ Yes ☒ No

PRINCIPAL HAZARDOUS COMPONENT(S) AND COMMON NAME(S)	% RANGE	OSHA PERMISSIBLE EXPOSURE LIMIT	ACGIH THRESHOLD LIMIT VALUE
Ammonium Nitrate	97-99	NA	NA

SECTION 3 – PHYSICAL AND CHEMICAL CHARACTERISTICS (Fire and Explosion Data)

BOILING POINT	Decomposes at 410°F	SPECIFIC GRAVITY (H_2O = 1)	1.72 @ 70°F	VAPOR PRESSURE	NA
PERCENT VOLATILE BY VOLUME (%)	NA	VAPOR DENSITY (AIR = 1)	NA	EVAPORATION RATE (_____ = 1)	NA
SOLUBILITY IN WATER	192g/100cc @ 68°F	REACTIVITY IN WATER	NA		
APPEARANCE AND ODOR	Solid, white color, and odorless.			FLASH POINT	NA

FLAMMABLE LIMITS IN AIR % BY VOLUME	LOWER	UPPER	EXTINGUISHING MEDIA	AUTO IGNITION TEMP
	NA	NA	Water	NA

SPECIAL FIRE FIGHTING PROCEDURES

Flood melted and burning ammonium nitrate with large volumes of low pressure water. Do not smother fire. Do not add steam, carbon dioxide, dry chemicals, foam extinguishers, or other smothering agents. Do not use salt water. Fight fire from protected location as steam eruptions are common and ammonium nitrate splashes are possible.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Nitrogen oxide gases emitted on decomposition are extremely toxic. Consideration must be given to change contamination of ammonium nitrate with oil, charcoal, sulfur, metal fines, or other combustible substances with possible explosion of entire mass. If an explosion is suspected, surrounding areas should be evacuated.

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MSDS 3

SECTION 4 — PHYSICAL HAZARDS

HAZARDOUS COMPONENTS: Ammonium Nitrate

STABILITY: ____Unstable __X__Stable — Conditions to Avoid: Avoid contamination with oxidizable matter. (See List Below)

INCOMPATIBILITY (MATERIALS TO AVOID): Avoid mixing ammonium nitrate with oxidizable materials (wood chips, organic materials, sulfur, chlorides, phosphorus, finely divided metals, acids, flammable liquids, charcoal).

HAZARDOUS DECOMPOSITION PRODUCTS: On heating decomposes to ammonia, nitric acid, and oxides of nitrogen.

HAZARDOUS POLYMERIZATION: ____May Occur __X__Will Not Occur — Conditions to Avoid: NA

OTHER HAZARDS: Oxidizer

SECTION 5 — HEALTH HAZARDS

HAZARDOUS COMPONENTS: None

SIGNS AND SYMPTOMS OF EXPOSURE:

1. ACUTE OVEREXPOSURE: If ingested, cyanosis, decrease in blood pressure, rapid heartbeat, rapid breathing, abdominal pain, weakness, and collapse can occur.

2. CHRONIC OVEREXPOSURE: Small repeated oral doses may lead to weakness, general depression, headache, and mental impairment.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Large doses may cause nausea and vomiting. Acidosis may occur in the presence of impaired renal function and also during prolonged use in persons with normal kidney function.

CHEMICAL LISTED AS CARCINOGEN OR POTENTIAL CARCINOGEN — NATIONAL TOXICOLOGY PROGRAM: ☐ YES ☒ NO — I.A.R.C. MONOGRAPHS: ☐ YES ☒ NO — OSHA: ☐ YES ☒ NO

EMERGENCY AND FIRST AID PROCEDURES:
Flush exposed area with water. Remove to fresh air. If ingested, administer water, milk, and raw eggs to make vomit.

ROUTE(S) OF ENTRY:

1. INHALATION
Inhaled dust may cause minor respiratory tract irritation.

2. EYES
May be irritating.

3. SKIN
Slightly irritating.

4. INGESTION
Ingestion of 8 to 15 grams of nitrate salt, may cause methemoglobinemia—chemical cyanosis. Classified as non-toxic.

SECTION 6 — SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE): A NIOSH/MSHA approved dust respirator should be used when exposure exceeds the OSHA nuisance dust standard.

VENTILATION: Provide local or general ventilation to keep dust below OSHA nuisance dust limit of 15 mg/m^3. — SPECIAL: NA

PROTECTIVE GLOVES: No protection normally required. If irritation occurs, long sleeves and impervious gloves should be worn. — EYE PROTECTION: Safety goggles should be worn if irritation exist.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

None

MSDS 3

SECTION 7 — SPECIAL PRECAUTIONS AND SPILL LEAK PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Store in cool, well ventilated area away from acute fire hazards and combustible materials. Avoid contamination. Floor drains and recesses should be plugged or eliminated to prevent entrapment of flowing, molten nitrate during fire.

OTHER PRECAUTIONS

Bagged ammonium nitrate is subject to storage, stacking, and quantity regulations. Follow Federal, State, and Local regulations. Detailed requirements are given in CFR 1910.109.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Contain large spill to prevent contact with waterways or vegetation. Prevent contamination with combustibles and keep away from heat.

The information, data, and recommendations in this material safety data sheet relate only to the specific material designated herein and do not relate to use in combination with any other material or in any process. The information, data, and recommendations set forth herein are believed by W. R. Grace & Co. to be accurate. W. R. Grace & Co. makes no warranties, either expressed or implied, with respect thereto and assumes no liability in connection with any use of such information, data, and recommendations.

Student Supplement 2A

MSDS 4

MATERIAL SAFETY DATA SHEET

Shell

97367 14-881

MSDS NUMBER ▸ 201,750-3

24 HOUR EMERGENCY ASSISTANCE	GENERAL MSDS ASSISTANCE	**BE SAFE** READ OUR PRODUCT SAFETY INFORMATION AND PASS IT ON (PRODUCT LIABILITY LAW REQUIRES IT)
SHELL: 713-473-9461 CHEMTREC: 800-424-9300	SHELL: 713-241-4819	

ACUTE HEALTH	FIRE	REACTIVITY	HAZARD RATING ▸	LEAST - 0	SLIGHT - 1	MODERATE - 2	HIGH - 3	EXTREME - 4
2	0	0						

*For acute and chronic health effects refer to the discussion in Section III

SECTION I	NAME
PRODUCT	▸ ATRAZINE 4L
CHEMICAL NAME	▸ 2-CHLORO-4, 6-BISPROPYLAMINO-S-TRIAZINE
CHEMICAL FAMILY	▸ AGRICULTURAL CHEMICAL
SHELL CODE	▸ 14230

SECTION II-A **PRODUCT/INGREDIENT**

NO.	COMPOSITION	CAS NUMBER	PERCENT
P	ATRAZINE 4L AATREX	MIXTURE	100
1	TECHNICAL ATRAZINE	1912-24-9	43.4
2	INERT FORMULATION COMPONENTS	*	56.6

* THE SPECIFIC CHEMICAL IDENTITY OR PERCENT N COMPOSITION OF COMPONENT 2 IS CONSIDERED TRADE SECRET INFORMATION. COMPONENT 2 CONTAINS ETHYLENE GLYCOL.

SECTION II-B **ACUTE TOXICITY DATA**

NO.	ACUTE ORAL LD50	ACUTE DERMAL LD50	ACUTE INHALATION LC50
P	1.06-1.69 ML/KG (RAT)	>2.0 ML/KG (RAT)	
1			>710 MG/L (RAT)

SECTION III **HEALTH INFORMATION**

THE HEALTH EFFECTS NOTED BELOW ARE CONSISTENT WITH REQUIREMENTS UNDER THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200).

EYE CONTACT
BASED ON PRODUCT TESTING. PRODUCT IS MILDLY IRRITATING TO THE EYES.

MSDS 4

PRODUCT NAME: ATRAZINE 4L

SKIN CONTACT
BASED ON PRODUCT TESTING. PRODUCT IS MINIMALLY IRRITATING TO THE SKIN.

INHALATION
BASED ON THE PRESENCE OF COMPONENT 2. VAPORS ARE MILDLY TO MARKEDLY IRRITATING TO THE LUNGS DEPENDING ON THE EXPOSURE LEVEL.

INGESTION
BASED ON PRODUCT TESTING, PRODUCT IS MODERATELY TOXIC AND MAY BE HARMFUL IF SWALLOWED. BASED ON THE PRESENCE OF COMPONENT 2, MAY PRODUCE CENTRAL NERVOUS SYSTEM (CNS) DEPRESSION AND KIDNEY DAMAGE WHICH MAY BE FATAL.

SIGNS AND SYMPTOMS
IRRITATION AS NOTED ABOVE. KIDNEY DAMAGE MAY BE EVIDENCED BY CHANGES IN URINE OUTPUT, URINE APPEARANCE OR EDEMA (SWELLING FROM LIQUID FLUID RETENTION).

AGGRAVATED MEDICAL CONDITIONS
PREEXISTING EYE, SKIN AND RESPIRATORY DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS PRODUCT. IMPAIRED KIDNEY FUNCTIONS FROM PREEXISTING DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS PRODUCT.

OTHER HEALTH EFFECTS
IN TESTING OF COMPONENT 1, ATAXIA, DYSPNEA, AND CONVULSIONS HAVE BEEN NOTED IN LETHALLY INTOXICATED EXPERIMENTAL ANIMALS.

SECTION IV **OCCUPATIONAL EXPOSURE LIMITS**

	OSHA		ACGIH		OTHER
NO.	PEL/TWA	PEL/CEILING	TLV/TWA	TLV/STEL	
1			5 MG/M^3		

SECTION V **EMERGENCY AND FIRST AID PROCEDURES**

EYE CONTACT
FLUSH EYES WITH PLENTY OF WATER FOR 15 MINUTES WHILE HOLDING EYELIDS OPEN. GET MEDICAL ATTENTION.

SKIN CONTACT
REMOVE CONTAMINATED CLOTHING/SHOES AND WIPE EXCESS FROM SKIN. FLUSH SKIN WITH WATER. FOLLOW BY WASHING WITH SOAP AND WATER. IF IRRITATION OCCURS, GET MEDICAL ATTENTION. DO NOT REUSE CLOTHING UNTIL CLEANED.*

INHALATION
REMOVE VICTIM TO FRESH AIR AND PROVIDE OXYGEN IF BREATHING IS DIFFICULT. GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING. GET MEDICAL ATTENTION.

INGESTION
DO NOT GIVE LIQUIDS IF VICTIM IS UNCONSCIOUS OR VERY DROWSY. OTHERWISE, GIVE NO MORE THAN 2 GLASSES OF WATER AND INDUCE VOMITING BY GIVING 30CC (2 TABLESPOONS) SYRUP OF IPECAC.** IF IPECAC IS UNAVAILABLE, GIVE 2 GLASSES OF WATER AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF VICTIM'S THROAT. KEEP VICTIM'S HEAD BELOW HIPS WHILE VOMITING. GET MEDICAL ATTENTION.

NOTE TO PHYSICIAN
**IF VICTIM IS A CHILD, GIVE NO MORE THAN 1 GLASS OF WATER AND 15CC (1 TABLESPOON) SYRUP OF IPECAC. IF SYMPTOMS SUCH AS LOSS OF GAG REFLEX, CONVULSIONS, OR UNCONSCIOUSNESS OCCUR BEFORE EMESIS, GASTRIC LAVAGE SHOULD BE CONSIDERED FOLLOWING INTUBATION WITH A CUFFED ENDOTRACHEAL TUBE.

MSDS 4

PRODUCT NAME: ATRAZINE 4L

SECTION VI **SUPPLEMENTAL HEALTH INFORMATION**

THE ACTIVE INGREDIENT WAS ADMINISTERED IN A CHRONIC FEEDING TO RATS AT 0, 10, 300, AND 1000 PPM. NO COMPOUND RELATED EFFECTS WERE NOTED IN ANY OF THE TREATMENT GROUPS FOR GROSS PATHOLOGY OR HISTOPATHOLOGY. TERATOLOGY STUDIES IN RATS AND RABBITS WERE NEGATIVE.

IN ONE STUDY, WHEN ETHYLENE GLYCOL WAS ADMINISTERED IN THE DIET AT DAILY DOSES UP TO 1.0 G/KG TO PREGNANT RATS, NO MATERNAL TOXICITY, NO EMBRYOTOXICITY NOR TERATOGENICITY WERE OBSERVED. IN A MORE RECENT STUDY, WHEN ETHYLENE GLYCOL WAS ADMINISTERED BY GAVAGE AT DAILY DOES OF 1.25 G/KG AND ABOVE TO PREGNANT RATS, OR AT 750 MG/KG AND ABOVE TO PREGNANT MICE, THERE WAS AN INCREASE IN THE NUMBER OF MALFORMED FETUSES AT ALL DOSE LEVELS. EXCEPT AT THE LOWEST DOSE LEVEL IN MICE, THERE WAS ALSO EVIDENCE OF MATERNAL TOXICITY AT ALL DOSE LEVELS.

SECTION VII **PHYSICAL DATA**

BOILING POINT: NOT AVAILABLE (DEG F)	SPECIFIC GRAVITY: 1.11 (H_20=1)	VAPOR PRESSURE: NOT AVAILABLE (MM HG)
MELTING POINT: NOT APPLICABLE (DEG F)	SOLUBILITY: DISPERSIBLE (IN WATER)	VAPOR DENSITY: NOT AVAILABLE (AIR=1)

EVAPORATION RATE (N-BUTYL ACETATE = 1): NOT AVAILABLE

APPEARANCE AND ODOR: WHITE, MOBILE LIQUID.

SECTION VIII **FIRE AND EXPLOSION HAZARDS**

FLASH POINT AND METHOD:
WILL NOT BURN

FLAMMABLE LIMITS / % VOLUME IN AIR
LOWER: N/AP UPPER: N/AP

EXTINGUISHING MEDIA
USE WATER FOG, FOAM, DRY CHEMICAL OR CO_2.

SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS
MATERIAL WILL NOT BURN UNLESS PREHEATED. DO NOT ENTER CONFINED FIRE SPACE WITHOUT FULL BUNKER GEAR (HELMET WITH FACE SHIELD, BUNKER COATS, GLOVES, AND RUBBER BOOTS), INCLUDING A POSITIVE PRESSURE NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS WITH WATER.

UNUSUAL FIRE AND EXPLOSION HAZARDS
NITROGEN OXIDES AND NITROGEN CONTAINING ORGANIC COMPOUNDS MAY BE RELEASED UPON COMBUSTION.

SECTION IX **REACTIVITY**

STABILITY: STABLE **HAZARDOUS POLYMERIZATION:** WILL NOT OCCUR

CONDITIONS AND MATERIALS TO AVOID:
NITROGEN OXIDES, CARBON MONOXIDE, AND UNIDENTIFIED ORGANIC COMPOUNDS MAY BE FORMED DURING COMBUSTION.

HAZARDOUS DECOMPOSITION PRODUCTS
NITROGEN OXIDES, CARBON MONOXIDE, AND UNIDENTIFIED ORGANIC COMPOUNDS MAY BE FORMED DURING COMBUSTION.

MSDS 4

PRODUCT NAME: ATRAZINE 4L

SECTION X EMPLOYEE PROTECTION

RESPIRATORY PROTECTION
IF EXPOSURE MAY OR DOES EXCEED OCCUPATIONAL EXPOSURE LIMITS (SEC. IV) USE A NIOSH-APPROVED RESPIRATOR TO PREVENT OVEREXPOSURE. IN ACCORD WITH 29 CFR 1910.134 USE EITHER AN ATMOSPHERE-SUPPLYING RESPIRATOR OR AN AIR-PURIFYING RESPIRATOR FOR PARTICULATES.

PROTECTIVE CLOTHING
AVOID CONTACT WITH EYES. WEAR SAFETY GLASSES OR GOGGLES AS APPROPRIATE. AVOID CONTACT WITH SKIN AND CLOTHING. WEAR CHEMICAL-RESISTANT GLOVES AND PROTECTIVE CLOTHING.

SECTION XI ENVIRONMENTAL PROTECTION

SPILL OR LEAK PROCEDURES
MAY BURN ALTHOUGH NOT READILY IGNITABLE. USE CAUTIOUS JUDGMENT WHEN CLEANING UP LARGE SPILLS.
***LARGE SPILLS — WEAR RESPIRATOR AND PROTECTIVE CLOTHING AS APPROPRIATE. SHUT OFF SOURCE OF LEAK IF SAFE TO DO SO. DIKE AND CONTAIN. REMOVE WITH VACUUM TRUCKS OR PUMP TO STORAGE/SALVAGE VESSELS. SOAK UP RESIDUE WITH AN ABSORBENT SUCH AS CLAY, SAND, OR OTHER SUITABLE MATERIAL; DISPOSE OF PROPERLY. FLUSH AREA WITH WATER TO REMOVE TRACE RESIDUE.
***SMALL SPILLS — TAKE UP WITH AN ABSORBENT MATERIAL AND DISPOSE OF PROPERLY. FOR DISPOSAL SEE BELOW.

WASTE DISPOSAL
PLACE IN AN APPROPRIATE DISPOSAL FACILITY IN COMPLIANCE WITH LOCAL REGULATIONS. CONSULT PRODUCT LABEL FOR SPECIFIC DISPOSAL INSTRUCTIONS.

SECTION XII SPECIAL PRECAUTIONS

STORE IN A COOL, DRY PLACE WITH ADEQUATE VENTILATION. KEEP AWAY FROM OPEN FLAMES AND HIGH TEMPERATURES.

SECTION XIII TRANSPORTATION REQUIREMENTS

DEPARTMENT OF TRANSPORTATION CLASSIFICATION: NOT HAZARDOUS BY D.O.T. REGULATIONS

SECTION XIV OTHER REGULATORY CONTROLS

THIS PRODUCT IS REGISTERED UNDER EPA/FIFRA AND AS SUCH IS NOT REQUIRED TO BE LISTED UNDER TSCA.

THE INFORMATION CONTAINED HEREIN IS BASED ON THE DATA AVAILABLE TO US AND IS BELIEVED TO BE CORRECT. HOWEVER, SHELL MAKES NO WARRANTY, EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF. SHELL ASSUMES NO RESPONSIBILITY FOR INJURY FROM THE USE OF THE PRODUCT DESCRIBED HEREIN.

DATE PREPARED: NOVEMBER 21, 1985

JOHN P. SEPESI

BE SAFE

READ OUR PRODUCT
SAFETY INFORMATION...AND PASS IT ON
(PRODUCT LIABILITY LAW
REQUIRES IT)

SHELL OIL COMPANY
PRODUCT SAFETY AND COMPLIANCE
P.O. BOX 4320
HOUSTON, TX 77210

Outdoor Safety and First Aid
Advanced Applications
Unit 1

Assignment Sheet 1A—Interpret Material Safety Data Sheets

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Ability to read and interpret data is evident from student's answers	_____

Introduction: It is important not only that all employees have access to MSDS report forms, but also that all employees know how to read and interpret the data on those forms.

Directions: Review the material in Objective 11 of the information sheet, and locate and study the information presented in Student Supplement 1A, "Guidelines for Interpreting Material Safety Data Sheets."

Next, locate and study the MSDSs presented in Student Supplement 2A, "Sample MSDSs." Use the MSDSs in Student Supplement 2A to answer the following questions. Write your answers on the blanks provided below each item.

The MSDSs supplied concern a popular fertilizer, an engine coolant found in vehicles and outdoor equipment, and a popular insecticide and a herbicide used in pasture and rangeland renovation activities.

MSDS 1—Cato Coolant (A typical antifreeze/coolant)

1. What is the main ingredient of this product?

   _____

2. What is the appearance of this product?

   _____

3. What emergency telephone numbers should one call for problems with this product?

   _____

4. To what temperature must this product be raised before it will ignite?

   _____

Assignment Sheet 1A

5. What type of fire extinguisher may be used on a fire involving this material?

_____

6. What hazardous materials can the combustion of this product cause?

_____

7. What effects can this product have if its fumes are inhaled?

_____

8. How may this product affect the skin?

_____

9. What may happen if this product is ingested?

_____

10. In concentrations of up to 500 parts per million, what respiratory protection is needed with this product?

_____

MSDS 2—Sevin 5% Dust (Common garden, lawn, and agricultural insecticide)

1. What is the main ingredient of this product?

_____

2. What is the appearance of this product?

_____

3. What type of fire extinguisher may be used to combat fires involving this material?

_____

4. What health hazards to the eyes might contact with this material cause?

_____

5. What may happen if this product is ingested?

_____

6. What symptoms may occur if this product is ingested?

_____

Assignment Sheet 1A

7. What respiratory protection is needed while handling this product?

_____

8. What skin protection is needed while handling this product?

_____

9. What first-aid measure should be taken immediately for a victim of inhalation of this product?

_____

10. What emergency telephone number is to be used for problems with this product?

_____

MSDS 3—Ammonium Nitrate (Common lawn and agricultural fertilizer)

1. What is the principal hazardous substance in this product?

_____

2. What emergency telephone number is to be used for problems with this product?

_____

3. What appearance does this product have?

_____

4. What is the recommended fire extinguishing agent recommended for fires involving this product?

_____

5. What harmful compounds are released when this product burns?

_____

6. What symptoms might be apparent if this product is ingested?

_____

7. What may happen if this product is inhaled?

_____

8. What affect does this product have on the skin?

_____

Assignment Sheet 1A

9. What type of respiratory protection is needed while handling this product?

_____

10. What other protective clothing is needed to handle this material?

_____

MSDS 4—Atrazine 4L (Brand name AATREX; common herbicide used in pasture and range renovation)

1. What emergency telephone numbers should be used for problems with this product?

_____

2. What is the main technical ingredient of this product?

_____

3. In addition to the main technical ingredient, what other compound does this material contain?

_____

4. What may happen if this material is splashed into the eye?

_____

5. What effect does this material have on the skin?

_____

6. What organs of the body might be severely affected if this product is ingested?

_____

7. What emergency first aid should be administered to a victim whose eyes have come in contact with this material?

_____

8. What first-aid action is required for a victim who has inhaled this product and is unconscious?

_____

9. At what temperature will this product burn?

_____

10. What hazardous products might be formed as this product burns?

_____

Outdoor Safety and First Aid
Advanced Applications
Unit 1

Assignment Sheet 2A—Analyze Current Reports Concerning Outdoor Safety and First Aid

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____

Introduction: Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to outdoor safety subjects.

Directions: Each day, newspapers, and weekly and monthly magazines, trade journals and scientific journals carry material related to health, safety, first aid, and various hazards. From these publications you are to collect a minimum of five current (within the past three years) articles dealing with areas of outdoor safety and first aid.

Summarize each of these articles, and write a report in which you analyze the content of the articles. Subject matter can vary, but examples might include: the controversy over first aid and secondary treatment of venomous snake bites; the application of cold or hot packs to sprains and fractures; the risks of mouth-to-mouth resuscitation in an era of concern over disease.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning outdoor safety and natural resources, consult the *Reader's Guide* in your school or community library.

Natural Resources and Conservation
Advanced Applications
Unit 2

Student Supplement 1A—The Hows and Whys of Compost

Soil

Unless one is an active gardener or thoughtful farmer, soil is soil. Or, "dirt" as some people call it.

Soil is more than an anchor for plants, however, and must be just as alive and vital as a growing crop for proper plant growth. In addition to providing plants nutrients from soil minerals, soil also must be capable of holding adequate water to supply plants, and it must be porous enough to allow water and oxygen-bearing air to percolate from the surface to surround actively growing root tips. Also, it should contain millions of microorganisms (beneficial bacteria) per cubic inch which also help plant growth through their conversion of organic matter into useable plant nutrients.

Sufficient amounts of organic matter are absolutely necessary. Organic matter (material rich in carbon) can come from many sources. Dead and dying plant material, vegetable wastes, used hay or straw and manure from livestock bedding and feeding areas, shredded newspapers—anything that will decompose back to the soil in a reasonable amount of time can be a source of beneficial organic matter.

For years farmers concerned with their soil have known that returning manure and crop residues to the soil helps prevent crusting of soil surfaces after heavy rains, prevents erosion, and generally helps crop production.

The rich prairie soils of the U.S. Great Plains were built up as, year after year, native prairie grasses died in the winter and fell to the ground to decompose as a mulch for the next year's stand of grass. Once settlers began plowing the prairies, they exposed those thousands of year's worth of organic matter to oxygen, which unleashed a chemical reaction in the soil that left much nitrogen (one of the important nutrients for plant growth) available to feed crops. Today, farmers and gardeners interested in improving their soil's productivity spend much time managing crop residues and returning organic matter to their soils.

Compost

To speed up the process of supplying organic matter to crop producing soils, many gardeners and some large scale farms use the process of composting organic matter to produce the black, fragrant, crumbly, partially digested organic residue from crop and garden waste called *compost.*

On large-scale cattle feeding operations in the High Plains of Texas, Oklahoma, Kansas, Colorado, and parts of Nebraska, where huge feedlots finish hundreds of thousands of cattle each year, manure from the feeding process is arranged in long, deep rows and composted into a friable, easily handled material which is an extremely popular natural fertilizer for nearby farms.

Across the nation, gardeners by the thousands tend to compost heaps where they place their yard and garden wastes to decompose into valuable soil-building compost. Kitchen wastes, animal manures, weeds, grass clippings and leaves, and shredded branches, all contribute to the productivity of these gardeners' soils.

Student Supplement 1A

There's nothing magic about making compost. It's a natural process that will occur anyway wherever organic matter decomposes. Composting just concentrates the process where a farmer or gardener can get the most benefit from the process.

To build a compost pile, use a mixture of green and dry materials. Green materials decompose rapidly; grass clippings, lettuce leaves, tomato and pea vines, and other succulent materials contain sugar and proteins that provide excellent nutrients for soil organisms. Dry materials, however, such as saw dust, small twigs and prunings and aged tomato vines etc., contain very little nitrogen and decompose rather slowly by themselves. By mixing green and dry material—along with animal manures or other materials rich in nitrogen, such as alfalfa hay—the pile will compost at a rapid rate. In fact, some expert gardeners can arrange their compost heaps in a manner which will turn shredded residues into useable compost in two to three weeks. For most, however, 6 to 12 weeks is required to produce the fluffy, black, naturally fresh-smelling product.

The size of the material being composted is important too. If dry leaves and other dry matter are put through a shredder (or chopped with a lawn mower) the small pieces will decompose much more rapidly because they have more surface area exposed to oxygen and decay organisms. Shredding also creates a fluffier mixture, allowing for more water and air penetration. If grass clippings are used, they should be mixed thoroughly into the pile to prevent them from matting and souring and attracting flies. (The putrification process comes from anaerobic (without oxygen) digestion. This process produces many compounds rich in ammonia and sulfur—which are unpleasant to the nose.)

To get the most from a compost heap, many have found alternating layers of green and dry material, along with layers of existing compost and animal manures provides an excellent base for the beginning of natural digestion. Wetting down the dry material as it is placed in the pile will help get the compost process started earlier and maintain it through several days of "digestion." Once the pile has been built to a height of three or four feet, a layer of soil or existing compost on top will serve as an insulator to hold naturally occurring heat within the pile. In a properly designed compost pile, the center of the pile will reach nearly 160°F for several days.

Once every three or four days the temperature of the pile should be checked with a thermometer. Once the inner temperatures begin to fall to only warm levels, the pile should be turned with a shovel or pitch fork to expose new material to microorganisms and oxygen. This will cause a repeat of the heating process, although the high temperatures will not last as long as the "fuel" of the pile is being consumed with each process. Once no more heating is observed, the compost should be ready to apply as a mulch or stored for later use.

A good way to manage this process is to build an area for three piles: one to accumulate kitchen and yard and garden waste; one to house the actively "working" pile and; one to store completed compost.

Tips for Composting

1. Compost piles of about a cubic yard (or meter) are easily managed and quite productive.

2. Shred material finely for quicker processing.

3. To improve quality of compost, add earth worms to it after it cools. Worms further digest the organic matter and actually add significant amounts of nitrogen to it in the process.

Student Supplement 1A

Troubleshooting a Compost Pile

The pile doesn't heat up:

1. The pile may be too small. Rebuild it and make it larger.

2. The pile may be too dry. Rebuild it, watering each layer thoroughly as you rebuild. This is especially important when layering dry materials.

3. The pile may contain too much dried material (and too little nitrogen). Turn it and add some high-nitrogen fertilizer, animal manures, or leafy green organic matter.

The pile produces objectionable smells:

1. If it smells like ammonia, it has too much high nitrogen matter. Layer in some straw, leaves, or sawdust.

2. If it smells like rotten eggs, it is too wet (not enough oxygen), turn it and layer in some dry matter.

The pile attracts pests:

1. If rodents and/or dogs are attracted to the pile, it may contain meat scraps or exposed manure. Remove the material or bury it deep in the pile.

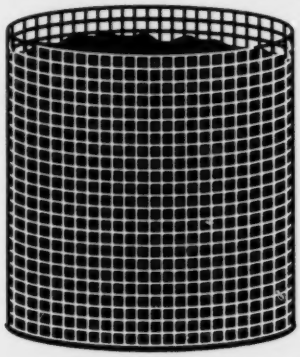
2. If insects are a problem, the pile is not heating properly. Insects cannot tolerate the heat of a properly operating compost pile. Also, once the heat has cooled, the material in the pile is decomposed sufficiently so as not to interest insects.

Structure

Structures for composting can be quite simple and inexpensive, but they must allow for easy handling of the material and flexibility in moving the material through its natural process.

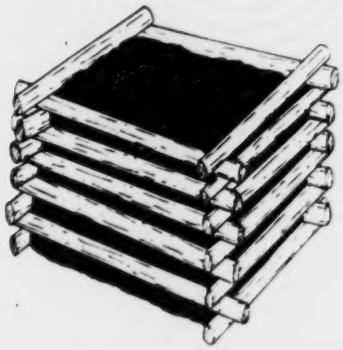
The accompanying illustrations give ideas on simple to more complex composting structures.

A. A simple bin can be made from a cylinder of wire fencing, livestock panel, or reinforcing mesh.

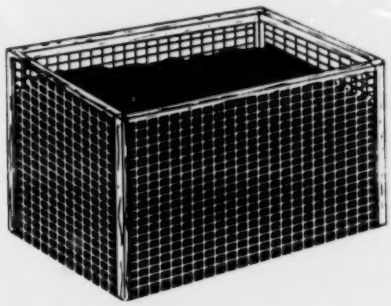


Student Supplement 1A

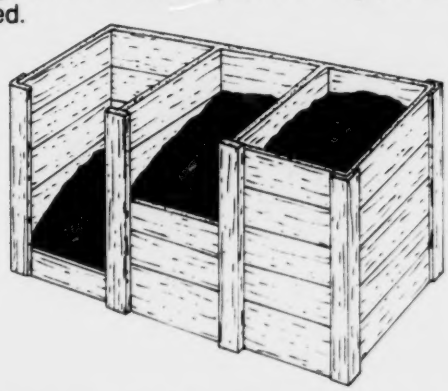
B. This bin, built "log cabin" style from landscape timbers or other posts, can be built without fasteners as it is filled. Its removable sides allow for easy access and oxygen and water penetration.



C. This bin is made by driving corner posts in the ground and wrapping with screen mesh. This design allows sufficient support for a cover to prevent damage from heavy rains or animals.



D. This more elaborate compost bin features removable front boards for easy access in loading, unloading, and stirring compost. Or, one bin can be used for accumulation of compostable material, one can be used for the active pile, and the other used for storage. Some producers alternate bins as they "turn" the "active" pile to an adjacent bin, and build a new pile in the bin most recently emptied.



Additional information on composting and compost structures is available at your state's land-grant university's Cooperative Extension office, most public libraries, and many gardening books and magazines available at bookstores.

Natural Resources and Conservation
Advanced Applications
Unit 2

Assignment Sheet 1A—Trace Route of Recyclable Products

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student actively took part in class exercise	_____
• Worked cooperatively with others	_____
• Final project report was thorough and well written	_____

Introduction: Throughout this unit the importance of recycling and wise use of natural resources has been emphasized. Many products are readily reusable and many communities have adopted recycling programs which provide centrally located sites for accumulating recyclable materials. But, what happens to those products? In this exercise class members will be assigned various recyclable products to research to trace their paths from the original use, through the recycling point and on to remanufacturing and their final market as a recycled product.

Your instructor will divide the class into groups according to recycled products being researched. For instance: used motor oil and engine antifreeze/coolant; cardboard and paper; plastic milk and soft drink containers; glass; aluminum cans and structural aluminum; copper; used batteries, etc. Each group will be responsible for tracking its assigned product from original use through the recycling site to a reprocessor and on to its next use as a recycled product.

Directions: Seek information from managers of recycling sites identified in Assignment Sheet 3 as a starting point. Other sources of information might include local retail outlets selling recycled products such as Wal-Mart, K-Mart, and others who sell recycled motor oil, batteries, etc. In addition, school and community libraries contain recent periodicals which feature material on recycling in the U.S. and what products are being developed from current waste material.

Using the above resources, and investigative skills of your own, employ the following list of questions to track the route of waste products assigned to you through the recycling process.

1. What uses has this product served before it came to the recycling center?

_____

_____

2. What processes will this product go through before it is sold to a remanufacturer? (Re-refining, crushing, melting, etc.)

_____

_____

Assignment Sheet 1A

3. How large a quantity of this product will be assembled before shipping to remanufacturer? (i.e., aluminum cans are sometime crushed into 40 lb. cubes for shipping)

4. Who is the purchaser of this recyclable material?

5. What does the purchaser do with the material? (Is it directly turned into a new product? Is it processed further before being sold again? Some used motor oils are merely used for boiler fuel, while others are re-refined into high grade American Petroleum Institute rated motor oil.)

6. How much time elapses before this recyclable product is again on the market for use as a recycled product? (Aluminum from recycled cars can be on the shelf holding beverages again in a matter of days.)

7. What products available locally might contain this recycled material within a short time?

8. How does the cost of this recycled material as a raw material compare with the cost of new material? (i.e., Cost of recycled paper fiber for a finished product compared with the cost of using new wood pulp fibers for the same product.)

9. How does the accumulator of this recyclable product secure sufficient quantities of the product to stay in business? (Advertising, word of mouth, contract waste removal?)

Assignment Sheet 1A

10. What is the public response for recycling this product...both for recycling the waste and purchasing the finished new product made from recycled material?

_____

_____

Based on your investigation and outside reading, write a report tracing the flow of the recycled material you were assigned from your community to a reprocessor and on to consumers as a new product made from recycled material. Your instructor will provide you with guidelines explaining the format of the finished report.

Natural Resources and Conservation
Advanced Applications
Unit 2

Assignment Sheet 2A—Complete a Class Community Service Project

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student actively took part in class exercise	_____
• Worked cooperatively with others	_____
• Final project report was thorough and well written	_____

Introduction: Throughout this unit the importance of natural resources and conservation has been emphasized. A number of subjects have been covered, from recycling and conservation actions, to identifying local pollution sources and problems. In this exercise you will be asked to work with your classmates to put your knowledge to action in a community service project which will positively affect the natural resources and environment of your community.

Directions: With your instructor serving as the meeting chairperson, as a class select and agree upon a project selected from the accompanying list, or one uniquely specific to your community, which will conserve or enhance natural resources or the community environment.

- A project similar to the clean up efforts in some states called "Adopt a Highway," in which a group agrees to remove litter from a specific amount of road or street right-of-way.
- A yard waste collection effort (which might feed the composting project found in Assignment Sheet 1A).
- A task force to collect used motor oil, or old, partially consumed paint cans, and discarded pesticide containers, aerosol bombs, etc. for proper disposal.
- A fund-raising event to help the needy insulate their homes for more efficient heating and cooling.
- A work project in which class members actually provide the labor and donated materials to weatherize homes of the elderly and needy for improved energy use in winter.
- A tree-planting project in community parks or other city and county landscapes. (Most states have forestry-department-related nurseries from which low-cost seedling trees adapted to specific uses may be obtained).
- A task force to collect discarded tires from the community for proper disposal. (Tires can be recycled, and those that remain in the environment many times hold puddles of rainwater which provide breeding places for mosquitoes).

Assignment Sheet 2A

- A composting project to turn local waste into useable mulch.
- An information campaign carried out through newspaper, radio and television interviews, point-of-purchase literature (at home improvement stores) to urge homeowners to seek an energy audit by local utility companies. (Work with local utility companies to obtain information and tips on community contacts).
- A class contest to research and build solar collectors from waste materials such as aluminum cans, scrap tempered glass, etc.
- A Christmas tree collection project used to accumulate trees after the holidays for use as fish habitat in local lakes and ponds, or for use as mulch. (Work with local wildlife department employees on pond structures for fish. Many cities have equipment to grind such trees into useable mulch and compost).
- A class cleanup of local stream and river banks.
- Work with local Natural Resources Conservation Service personnel, or wildlife department employees in planting wildlife food and cover plots.
- Build and sell bird houses and bird feeders to community residents. (Plans are available from most state wildlife conservation departments, or through land-grant university Cooperative Extension offices).
- Work with local park officials to identify and label the different species of trees, grasses, and shrubs in parks and other public use areas.
- Work with city officials in planting flowers, shrubs, and other landscape species in city beautification projects.
- Conduct a "paper drive" in which old newspapers are collected for recycling.
- Plant windbreaks and wildlife habitat crops on school property to control snow drifting, hot winds, and to provide for increased game and non-game species near your school. (Work with wildlife department officials and forestry or Natural Resources Conservation Service personnel).

Once your class has selected a community service project and, with the help of your instructor, assign various duties to class members to accomplish. Keep records, take pictures, and collect news articles concerning your project. Write a report explaining the importance of the project to your community, using the information you have collected.

Natural Resources and Conservation
Advanced Applications
Unit 2

Assignment Sheet 3A—Analyze Current Reports Concerning Natural Resources and Conservation Conflict Areas

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____

Introduction: As part of your ongoing study of current events as they relate to this unit of instruction, this assignment will allow you to explore the various factions and viewpoints involved in natural resources and their use.

Directions: From publications in your school and community library and local, state, and national newspapers, you are to collect a minimum of five current (within the past two years) articles dealing with areas of conflict (outlined in Objective 6 of this unit).

Summarize each of these articles, and write a report in which you analyze the content of the articles, emphasizing the need to protect the environment and natural resources with the economic aspects and constitutionally protected rights of private property owners.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning outdoor safety and natural resources, consult the *Reader's Guide* in your school or community library.

Natural Resources and Conservation
Advanced Applications
Unit 2

Job Sheet 1A—Build and Use a Composting Site

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation criteria	Rating
• Directions were followed	_____
• Student actively took part in project	_____
• Worked cooperatively with others to reach a common goal	_____
• Constructed minimum of three composting bins	_____
• Useable compost produced and stored properly in bins	_____
• Compost temperatures monitored and tracked daily	_____
• Secured market for finished compost	_____
• Final project report was thorough and well written	_____

Introduction: Throughout this unit the importance of recycling and wise use of natural resources has been emphasized. Composting was listed as one of the ways material many call waste can be used to enhance the productivity of the soil at the same time it limits the amount of material stored in landfills. Using the information in Student Supplement 1A and other materials readily available at your school or community library, the class will build and operate a composting site to learn how composting can both protect and benefit the environment.

Directions: Before beginning this activity, your instructor will divide the class into groups assigned the following specific tasks:

1. Secure a dependable supply of compostable material such as yard clippings and garden waste; cafeteria and kitchen wastes; a limited amount of old newspapers, etc. Seek this material from lawn enthusiasts, restaurants, and the school cafeteria.

2. Secure a dependable supply of materials high in nitrogen such as animal or poultry manures, relatively fresh green leafy plant material, dried blood (from packing houses) or any other waste products high in nitrogen. (Do not use meat products or waste!) Seek these materials from the school agricultural education classes, local horse or poultry farms, zoos, dairies, animal feeding areas, or meat packing plants.

3. Secure the necessary materials to build an easy-to-use inexpensive compost bin. This can be reinforcing mesh wire, concrete blocks, landscape timbers, old railroad cross ties, or anything else that will contain a compost pile while it works for the community. (Use your imagination. The less expensive the material, the better the project!)

4. Secure a "market" for the finished compost such as garden club members, school landscape crews, city parks and recreation crews, or local truck farmers, and greenhouse owners.

Job Sheet 1A

5. Select one member from each team to serve on a special committee to promote this project as a community service, emphasizing the dual benefits of reducing wastes and creating a needed product. This committee should seek attention from school and community newspapers and radio and television stations.

Your instructor will observe and rate your performance using the evaluation criteria.

A. Equipment and materials

- Items listed in 1-3 above and Student Supplement 1A
- Other creative materials

B. Procedure

☐ 1. Select a site suitable for recycling wastes in a compost operation. Use ideas from Student Supplement 1A, material gathered from gardening books, and pamphlets from your state's land-grant university Cooperative Extension service.

☐ 2. Assemble the necessary materials to make at least three bins or containment areas to hold the following:

- Compostable material collected by the collection committee
- An active compost pile
- Finished product bound for the "market"

☐ 3. Store compostable material in constructed bin and build an active compost pile.

☐ 4. Work in teams of two, as assigned, to monitor the compost pile's inner temperature, and add material and stir as necessary. Record daily temperatures to track the biological activity inside the pile as noted in Student Supplement 1A.

☐ 5. Remove the cooled material from the active bin (once it shows no new signs of heating again) and store it until it can be used. As the active bin becomes available, start the process again, moving the composting materials in and out of the composting site.

Note: Regardless of the weather, as long as the compost pile is layered properly and contains the correct amount of nitrogenous materials (greens and manures) and high carbon materials (dried plant materials) along with the proper water content, it will heat and produce compost. In extreme winter weather, cover the pile with a plastic tarp to maintain composting temperatures and bacterial activity.

☐ 6. Write a report on the project, detailing how it was organized, where the materials were secured, how the class worked as a team to produce a useable product from what otherwise would have been thrown away, and "success" stories from those who received the finished product—how they used the material and the results they have had or expect to have. Cite examples of how working with the school and community newspapers and broadcast outlets helped make the project a success.

Job Sheet 1A

Evaluator's comments: _____

_____

_____

_____

Water Resource Management
Advanced Applications
Unit 3

Student Supplement 1A—Maximum Contaminant Levels & Lifetime Health Advisories

The currently registered pesticide active ingredients listed below are in various stages of federal regulation. Maximum Contaminant Levels (MCLs) are enforceable standards for public drinking water supplies. MCLs have been proposed for many high volume use pesticides (Table 1). MCLs are set to protect against adverse health effects and should be considered safe levels.

The Environmental Protection Agency also has set lifetime health advisories for many other pesticides occasionally found in groundwater (Table 2). Health advisories are not enforceable standards, but can be used to assess potential health effects. Health advisories include a 100 to 1000 fold margin of safety. Water containing pesticides at or below the lifetime health advisories should be considered safe for lifetime consumption.

Table 1. Pesticides with Proposed MCLs (ppb)

2	**alachlor**-Lasso®
3	**atrazine**-Atranex, Crisazina®
10	**aldicarb**-Temik®
40	**carbofuran**-Furdan, Curaterr®
5	**1,2 dichloropropane**-Propylene dichloride
70	**2,4-D**-Auqa Kleen®
200	**Pentachlorophenol**-PCP
400	**methoxychlor**-Malate®, DMDT, Methoxy-DDT

Table 2. Pesticide Lifetime Health Advisories (ppb)

60	**ametryn**-Ametrex, Gesapax®
20	**bentazon**-Basagran®
700	**butylate**-R-1910, Sutan®
700	**carbaryl**-Sevin®
10	**cyanazine**-Bladex
200	**dalapon**-Dowpon, Ded-Weed®
200	**dicamba**-Banvel®
7	**dinoseb**-DNBP, Dinitro
200	**diphenamid**-Dymid®, Enide®
10	**diuron**-DCMU, Karmex®
2	**fenamiphos**-Nemacur®
200	**Hexazinone**-Velpar®
100	**metolachlor**-Dual®, Primextra®
200	**metribuzin**-Lexone®, Sencor®
200	**oxamyl**-Vydate®, DPX-1410
200	**Pentachlorophenol**-PCP
500	**pichloram**-Tordon®
100	**propham**-IPC, Beet-Kleen®
90	**terbacil**-Sinbar®
1	**terbufos**-Counter®
5*	**trifluralin**-Treflan® (*EPA letter)
0.2	**1,3 dichloropropene**-DCP, Telone
1	**acifluorfen**-Blazer®, Carbofluorfen, Tackle®
3	**baygon**-Propoxur, Unden®, Blattanex®
90	**bromacil**-Borea®, Hyvar®, Uragan®
700	**carboxin**-D-735, DCMO, Vitavax®
100	**chloramben**-Amiben, Vegiben®
2	**chlorothalonil**-Bravo, Daconil®
0.6	**diazinon**-Spectracide®, Basudin®, AG-500
0.3	**disulfoton**-Disyston®, Dithiodemeton®
0.2	**ETU**-Breakdown of EBDC pesticides
90	**fluormeturon**-Cotoron®, C-2059
0.02	**hexachlorobenzene**-HCB, Perchlorobenzene
200	**methomyl**-Dupont 1179, Lannate®, Nudrin®
400	**methoxychlor**-Malate®, DMDT, Methoxy-DDT
100	**prometon**-Gesafram®, Pramitol®
50	**pronamide**-Kerb®, Propyzamide
90	**propachlor**-Bexton®, Ramrod®
10	**propazine**-Gesomil®, Milogard®, Primatol P®
4	**simazine**-Princep®, Aquazine®
500	**tebuthiuron**-Graslan®, Spike®

Water Resource Management
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Unit 3

Student Supplement 2A—Water Facts

1. Seventy-one percent of the earth's surface is covered with water.
2. The body of an adult human is made up of 65 percent to 70 percent water.
3. A human can survive only five to seven days without water.
4. A leaking faucet can waste up to 100 gallons of water per day.
5. Evenly distributed, the earth's annual rainfall could cover every square foot of land to a depth of about three feet.
6. In one summer day a single willow tree can use and lose more than 5,000 gallons of water.
7. An acre of corn produces more atmospheric water vapor than a lake of the same size.
8. Three quarters (75 percent) of the weight of a living tree is water.
9. The average American uses the following amounts of water:
   a. 40 gallons for one load of clothes in a washing machine
   b. 5 gallons of water per flush of the toilet × 6 flushes a day for a total of 30 gallons
   c. 30 gallons for a shower
   d. 4,000 gallons of water for a 1-inch irrigation of an average lawn
   e. 2 gallons of water to brush teeth (if the water is allowed to run throughout the process)
   f. 20 gallons of water to run a load of dishes in an automatic dishwasher
   g. 168 gallons of water total household use per person per day
10. A ten-minute shower without a flow restrictor consumes about 55 gallons of water.
11. A typical bath can consume 25 to 50 gallons of water.

Water Resource Management
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Unit 3

Student Supplement 3A—Water Conservation Methods for Household Activities

Significant amounts of water can be saved by individuals without drastically altering their habits or comfort levels.

Considering the typical shower can consume up to 55 gallons of fresh water in ten minutes, the addition of an inexpensive flow restrictor can reduce that amount to 20-30 gallons. Of course reducing the time spent in the shower directly affects the amount of water consumed, so shorter, more efficient showers can add up to many gallons of water saved.

Baths, too, can waste water, especially if the tub is filled to the maximum.

Many automatic washing machines consume up to 40 gallons of water per washing cycle. Newer machines are designed to operate with less water, but unless you are purchasing a new washing machine these efficiencies are not a practical solution. Washing only full loads will get the most of the water your washer requires. This requires planning and a little sorting management, but the water saved can be significant.

Dishwashers, too, consume a given amount of water, usually around 20 gallons, for each cycle. Again, washing only full loads will get the most for your water consumption. If you are purchasing a new dishwasher, be certain to shop for the most energy and water efficient models you can afford.

Car washing can consume large amounts of water, especially if a garden hose is used without a hose-end nozzle that is capable of being turned off. A good method to use to save at-home car washing water is to rinse the vehicle thoroughly, then turn off the water. Using a bucket of soapy water and a sponge or wash cloth, clean sections of the car thoroughly and rinse each as you finish. Once the entire vehicle has been cleaned, rinse it again thoroughly and turn the water off. Using a clean bucket of water, soak a chamois skin and wring it out before drying the vehicles glass and sheet metal.

Another waste of water comes in cooking and brushing teeth, as a faucet is left running when only a small amount of rinse water is actually needed. In some cases a person brushing teeth can consume up to 2 gallons of water when only a few ounces actually are needed to rinse the brush and mouth. Running a faucet while peeling potatoes or other vegetables is another wasteful habit. A pan of water works quite well to rinse vegetables and catch peelings, and it saves many gallons of water that otherwise would run down the drain, unused.

Lawn and garden watering can consume many thousands of gallons of water needlessly. True, landscape and lawns need water and when dry weather is parching the soil they must be irrigated adequately to prevent their deaths. But, most homeowners water too much, or provide wasteful inadequate waterings which consume water but don't help the plants. Some tips for getting the most of your landscape watering include:

1. Water at night when wind and evaporation rates are lower.

2. Use trickle irrigation or "weep" hoses in permanent flower beds and vegetable gardens. The water efficiency is much higher with these more precise water application tools.

Student Supplement 3A

3. In extremely dry weather, let the lawn take care of itself...especially in southern climates where bermudagrass is the lawn of choice. It may look brown and dead, but with the first rain it will "green up" almost immediately.

4. Plant ornamentals that require less water than others. So-called Xerographic landscaping takes advantage of cactus and other low water requirement plants to provide outdoor beauty and efficient water use in the landscape.

Another source of water waste is in inefficient plumbing fixtures, particularly those with dripping leaks. A dripping faucet can waste anywhere from 10 to 100 gallons a day depending upon its severity. Usually these leaks can be repaired with a washer that costs less than $1 at local department stores. Leaking toilets, those which run continually or periodically run to fill the flush tank, are major wasters of fresh water. If you can't repair them yourself, ask a friend or a plumber to make the necessary adjustments or repairs.

Also, be aware of water-efficient toilets when choosing appliances for new installation or remodeling projects. The difference between a toilet that uses only 2 gallons per flush and one that uses more than 5 gallons can be significant over the life of the appliance.

Water Resource Management
Advanced Applications
Unit 3

Assignment Sheet 1A—Calculate and Draw Conclusions from Water Measurements

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Calculations are correct	_____
• Conclusions show thoughtful consideration and judgment	_____
• Assignment was completed on time	_____

Introduction: News reports carry nearly daily examples of research findings citing alleged health hazards from pollution of water, air, and soil. Usually these reports will cite pollution levels found in increments of parts per million, billion, or trillion. This exercise is designed to acquaint you with the relative size of these minute quantities of pollutants in relation to the water, air, or land around them. In addition, this exercise will give you additional practice in calculating water flows and volumes.

Directions: Using the water measurement figures from Objective 14 in the Information Sheet, and additional figures given in this assignment, complete the following problems.

1. A flat-bottom municipal swimming pool measures 100 feet by 50 feet and is filled to a dept of four feet. How many gallons does this pool contain?

   (Hint) Multiply the length times the width, then multiply that figure times the depth to arrive at the number of cubic feet occupied by the water. Then multiply that number times 7.48 (the number of gallons of water in a cubic foot) to arrive at the answer.

   _____

2. The Arkansas River in central Colorado is a prime white water rafting area for thousands of rafters a year. Its flow varies from about 2,000 cubic feet per second during the spring when nearby mountain snows are melting, to about 700 cubic feet per second in the heat of August. If you planned to make a raft trip on the Arkansas and one of the rafting outfitters told you the river's flow was 800 cubic feet per second, how many gallons of water would be flowing across any given point of the river in a second?

   a. _____

   Now, imagine that amount of water stored in 55-gallon drums. How many 55 gallon drums would that amount of water involve? (round up to the nearest drum).

   b. _____

Assignment Sheet 1A

If the average American uses 168 gallons of water per day in household use, how many Americans would a minute's flow of the Arkansas River supply if it were running at 800 cubic feet per second? (round down to the nearest whole number).

c. _____

3. A water quality test shows traces of the herbicide atrazine in your drinking water supply at the level of 1 part per billion. Based on information supplied in Advanced Student Supplement 1, would you have reason to be worried over this level of contamination?

Why or why not? _____

_____

_____

4. A television station in your state has surveyed water quality results from a number of towns and has broadcast a story questioning the safety of several water supplies. Your hometown water supply was found to contain the common home garden and agricultural pesticide carbaryl (Sevin) at a level of 200 parts per billion. Given the information on Pesticide Lifetime Health Advisories in Student Supplement 1A, would you have reason to worry about your health?

Why or why not? _____

5. Imagine a flat-bottom swimming pool as long as a football field (300 feet) and 115 feet wide, filled to a depth of four feet. For ease of computing, let's say that pool contains exactly 1,000,000 gallons of water, although the actual figure is 1,032,240 gallons. One million gallons of water is equivalent to 128 million ounces. Which of the following would most closely amount to one part per million if it were spilled in this giant pool?

_____a. An eight ounce carton of chocolate milk

_____b. A one-ounce bottle of perfume roughly the size of a tube of lipstick

6. If the example in problem 5 is representative of a part per million, how much smaller would it have to be to represent a part per billion?

a. _____

How much smaller would the example in problem 5 have to be to represent a part per trillion?

b. _____

In your opinion, do you think the average television viewer has a realistic idea of the difference between parts per million and parts per trillion?

c. Why or why not? _____

_____

_____

Water Resource Management
Advanced Applications
Unit 3

Assignment Sheet 2A—Determine Ways to Reduce Home Water Consumption

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Conclusions show thoughtful consideration and judgment	_____
• Assignment is neat	_____
• Assignment was completed on time	_____

Introduction: The typical American uses an average of between 150 to 200 gallons of water per day in household consumption. In this exercise, you will be asked to evaluate your own uses of water and make suggestions of how you can significantly reduce the amount of water you use individually.

Directions: Using the information in Student Supplements 2A and 3A, consider your personal habits and routines as they apply to the following water uses and make suggestions on ways you can save water.

1. Bathing _____

_____

_____

2. Laundry _____

_____

_____

3. Brushing teeth _____

_____

_____

4. Washing vehicles _____

_____

_____

Assignment Sheet 2A

5. Plumbing fixture leaks _____

_____

_____

6. Outdoor yard/garden watering _____

_____

_____

Water Resource Management
Advanced Applications
Unit 3

Assignment Sheet 3A—Research EPA "Superfund" Sites in Your State

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Report is complete and well documented	_____
• Assignment is neat	_____
• Assignment was completed on time	_____

Introduction: In an effort to clean up severely polluted areas around the U.S., the Environmental Protection Agency has established a so-called "Superfund" for cleanup of specific sites it determines to be the most urgently in need of attention. Many times these include old strip mine pits, sites of smelters, hazardous waste dumps of the past, etc. This assignment is aimed at acquainting you with the pros and cons of so-called "Superfund" clean-up projects and the number of these sites in your own state.

Directions: Use the following list of questions to research the "Superfund" activity in your state and to document the status of those sites. Also, collect information on the activities that caused the sites to become polluted, and research the overall acceptance of the "Superfund" classification of residents near the sites. With the information you gather for this project, write a report detailing your state's "Superfund" activity, when it should be complete, and a personal assessment of the overall environmental effectiveness of the program in your state.

1. How many Superfund sites are established in your state?
2. Which of these sites are actively being cleaned under the auspices of the EPA Superfund?
3. If any are not being modified under EPA Superfund regulations, why are they not?
4. List the reasons why each site became polluted, when it became polluted, and note the threats to the environment posed by each.
5. Determine the amount of federal appropriations through the Superfund that is allotted to clean up of each site. Also determine the total amount of Superfund dollars your state may expect to be spent when all sites have been dealt with.
6. If communities near Superfund sites in your state have objected to the classification, research local and state newspaper accounts to determine why they don't want Superfund status.
7. Through local and state newspaper accounts of the Superfund sites in your state, determine if you think Superfund status is really justified. Why or why not?

Water Resource Management
Advanced Applications
Unit 3

Assignment Sheet 4A—Analyze Current Reports Concerning Water Resource Management

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____

Introduction: As part of your ongoing study of current events as they relate to this unit of instruction, this assignment will allow you to explore the various factions and viewpoints involved in water resource management.

Directions: From publications in your school and community library and local, state, and national newspapers, you are to collect a minimum of five current (within the past two years) articles dealing with areas of conflict in water resource management (urban/agriculture; agriculture/recreation; etc.)

Summarize each of these articles, and write a report in which you analyze the content of the articles, emphasizing the need to use and protect water resources for the benefit of the varied interests involved.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning water resource management, consult the *Reader's Guide* in your school or community library.

Land Management
Advanced Applications
Unit 4

Student Supplement 1A—Fertilizer Analysis

Whether one is growing houseplants, a suburban lawn, or thousands of acres of wheat, the use of fertilizer is necessary to provide proper plant growth and health. Plants require three basic nutrients for survival: nitrogen (N), phosphorus (P), and potassium (K). Other trace elements are necessary for plant growth also, but they are needed in only minute amounts, and in most cases these elements—boron, manganese, sulfur, iron, zinc, and others—usually are found naturally-occurring in sufficient quantities in most soils.

Although a controversy exists between "organic" growers and more traditional growers who use fertilizers produced synthetically, plants distinguish no difference between nitrogen derived from cow manure or nitrogen derived from natural gas. In all cases, the plant can only take up nitrogen in the nitrate or ammonium form, and regardless of the source, any nitrogen used by a plant has to be in one of those forms. So-called "organic" fertilizers must be converted by soil microbes to a nitrate form before the plant can use them, whereas ammonium nitrate is readily available to the plant immediately.

The basis of modern agriculture's ability to feed the industrialized world as well as much of the developing populations is commercially-produced fertilizer. To use naturally occurring fertilizers such as manures to produce the quantities of food required today, would require many more animals than exist and would require the shifting of many fields currently growing human food to fields producing forages and grains for animals. Still, the controversy over fertilizer sources exists and probably will continue for the foreseeable future.

Given the plant's need for N, P, and K, most fertilizers are blended to meet those needs in some fashion.

Chemicals such as monoammonium sulphate, ammonium nitrate, urea, diamonium phosphate, and murated potash are combined in quantities to equal certain percentages of N, P, and K. The "analysis" or the content of such fertilizer is denoted on the bag or bulk order as a numerical ratio. For instance, 5-10-5 would denote a fertilizer mixture consisting of 5 percent N, 10 percent P, and 5 percent K. 34-0-0 would be 34 percent N, and zero P and K.

Any mixture containing all three basic plant nutrients is referred to as a "balanced" fertilizer, although continuous use of such mixtures does not assure proper plant nutrition year in and year out. For instance, on a bermudagrass lawn in the south, the use of a 10-20-10 fertilizer over a period of years will lead to a buildup of P and K in the soil. Bermudagrass is a vigorous consumer of nitrogen, which moves in the soil with water infiltration and can evaporate into the atmosphere if it is not taken up by a plant. But, P and K are relatively stable in the soil, not moving with infiltrating water, and needed in only small quantities for proper root growth and water handling abilities of the bermudagrass plant. So, with several years of application, the 10-20-10 fertilizer is meeting the nitrogen needs of the grass, but the P and K components are being wasted because they are being applied in far greater amounts than the plant can consume. And, not being consumed they build up in the soil. Although no evidence is found that this is harmful, it is wasteful and expensive.

The only way to properly use such fertilizer is to perform regular soil tests and have laboratory analysis, based on the plant being grown, to guide one on amounts and types of fertilizer to be applied.

Student Supplement 1A

For nitrogen fertilizers, several chemicals are used because of their varying concentrations of N. For instance, ammonium nitrate provides about 33 percent of its weight in actual nitrogen. Urea contains 46 percent nitrogen. Anhydrous ammonia (NH_3), a pungent gas that must be incorporated into the soil with special applicator knives, is 82 percent nitrogen.

Various fertilizer combinations are available for various uses.

Examples include:

- Ammonium nitrate (34-0-0)—Usually applied to lawns and gardens. Seldom used agriculturally because of its greater cost per pound of nitrogen than other alternatives
- Diammonium phosphate (18-46-0)—A popular agricultural fertilizer which, with one compound, can supply two of the important plant nutrients, N and P
- Urea (46-0-0)—A lawn and agricultural fertilizer
- Anhydrous ammonia (82-0-0)—An agricultural fertilizer, usually providing the lowest nitrogen cost per pound
- Triple 17 (17-17-17)—A popular agriculture fertilizer blend
- 5-10-5—A popular lawn and garden fertilizer
- 10-20-10—A popular lawn and garden fertilizer
- 15-30-15—Miracle Gro* All Purpose Plant Food

Although fertilizer-is-fertilizer, the cost of certain ingredients can make one blend much more attractive than others. For instance, a farmer might want to put 50 lbs. of actual nitrogen per acre on a 100 acre field. Using 10-20-10 purchased in bulk for $200 a ton the farmer would have to use 500 lbs. of 10-20-10 per acre (10 percent nitrogen × 500 = 50 lbs.) at $50 per acre, or a total cost of $5,000 to accomplish this goal. At the same time the use of 10-20-10 would also apply 100 lbs. of P and 50 lbs. of K, whether it was needed or not. At the local co-op, the farmer can arrange to purchase anhydrous ammonia for $200 per ton, and with an N analysis of 82 percent, apply about 61 lbs. per acre to accomplish the same goal. That application would cost $6.10 per acre or a total of $610 to do the same thing the $5,000 application of 10-20-10 would accomplish. (2000 lbs. anhydrous ammonia at $200 = 10 cents per lb. × 61 lbs. per acre × 100 acres = $610.)

If one knows the cost per pound of plant nutrients, the cost scenarios can be applied to lawn and garden fertilizer for considerable savings for the home and garden.

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Advanced Applications
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Student Supplement 2A—Soil Drainage Suitability for Septic Systems

As more people move from cities and towns served by common sewer systems to rural and suburban areas which rely on septic systems to treat household wastewater, proper site selection for homes depends a great deal on the permeability of the soil and its ability to absorb treated waste.

A septic system consists of a large (usually 750 to 1000 gallons) underground baffled concrete container into which household and bathroom wastewater flows. As the material enters the tank from one end, bacteria which thrive in the absence of oxygen (anaerobic) begin digesting it into carbon dioxide, hydrogen sulfide, methane, and water. The solids settle to the bottom and the liquids pass on through a set of baffles until they reach the exit port in the tank at the other end. Once the liquid leaves the septic tank it flows through underground lines to "lateral" lines buried 18 to 24 inches in the soil. Laterals are perforated to allow the liquid to come in contact with the soil where it is absorbed and dispersed in the lower layers of the top soil and upper layers of subsoil. If the system is working properly, odors and solids are not present as the waste water works its way into the soil.

To ensure such a system works properly, a loamy soil is recommended by most public health departments, the agencies which test potential homesites for suitable soils for septic systems. Too much clay will not allow proper absorption and water movement (percolation), while too much sand will cause rapid leaching of the wastewater before soil bacteria have had the opportunity to further digest any organic wastes still in suspension.

To determine a suitable site before a home or business planning to use a septic system is constructed, representatives of state health departments conduct a percolation test—or "perc test"—to determine if the soil is suitable for proper septic tank drainage. A percolation test is accomplished by digging a series of holes 12, 24, 36, and 48 inches deep in the area where a septic system's laterals might be installed. Those unlined holes are filled with water and observed as the water soaks into the soil. The average time for a 1-inch drop is determined and compared with the following U.S. Health Department criteria:

- 40 or fewer minutes—Successful percolation
- 40-60 minutes—Moderate percolation
- 60 or more minutes—Limited percolation

Approval of a septic system depends upon state regulations, soil types, and the estimated wastewater load of the potential system.

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Student Supplement 3A—GIS: An Explanation

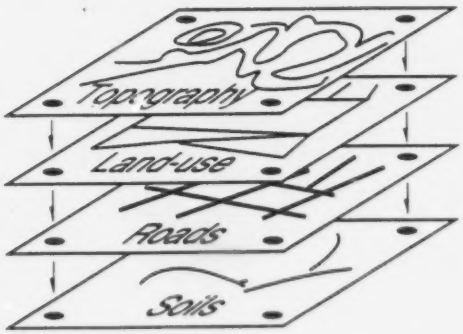
The following article was written by Chris Johnson, USDA Extension Service and Cooperative Extension Service/Ag Research, Purdue University, and was printed in the Conservation Technology Information Center's monthly newsletter, Conservation Impact, October, 1994.

Geographic Information System (GIS) technology is expanding very quickly and has applications in public safety, natural resource management, environmental analysis, utilities, and government. Crop production and soil management also offer several opportunities to use GIS.

What is it?

A GIS is designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical in the analysis. For example, the location of a landfill or location where soil erosion is most severe are key considerations in using a GIS. In each case, what it is and where it is are very important to the user for analysis.

Conceptually, a GIS can be envisioned as a stacked set of map layers (see graphic), where each layer is aligned or registered to the other layers. Each layer can contain a unique graphic theme or data type. These themes might include topography, soils, land-use, land ownership, or infrastructure such as roads, pipelines, power lines, or sewer networks. Since the themes or map layers have the same geographic location as a reference, they can be overlaid in any user-specified combination.



The most common GIS provides automated versions of traditional map analysis and map overlay is probably the most common function. Assuming the maps are in a digital format and ready for analysis, the user can quickly retrieve, overlay, manipulate, and analyze any number or combination of layers.

A true GIS includes data, computer hardware, software, and users.

The GIS has to have all these components to be a GIS. In fact, assembling data and putting it into a GIS can account for more than 70 percent of the cost of assembling a GIS.

Spatial and attribute data

Since data are so important, view the GIS as a data-centered approach. An individual or organization collects and compiles the data to support the goal of the user. The other components provide the support needed to process the data.

Student Supplement 3A

All data in a GIS are either spatial data or attribute data. Spatial data tells us where something occurs. Attribute data tells what occurs; therefore, it tells us the nature or characteristics of the spatial data. For example, you might describe the location of an irrigation well as a point with specific coordinates in degrees, minutes, and seconds for both longitude and latitude. Now, the attributes of the well such as depth, yield, water quality, and proximity to another well can be reported.

GIS in use

The following are but a few of the many ways GIS can provide practical help.

1. Prediction of crop production—An overlay of data from aerial/satellite photos with a soil map in conjunction with a yield model could provide crop yields or production for a specific area.

2. Land use changes—Overlaying map information from several different dates can illustrate the changes that have occurred and provide a comparison between categories (i.e., development of rural acres or farmland.)

3. Prediction of farm equipment needs—Assessment of land use/land cover (i.e., specific crops) by GIS layers of soil types, land ownership, and similar information can help forecast tillage changes, crop changes, and other factors.

4. Calculation of crop losses—This could be due to drought, flooding, or hail damage. Overlaying the affected area over a soil map could provide the needed information. Adding field boundaries could provide the capability to provide this information by individual owner.

5. Site-specific, variable rate systems—Maps and associated data bases are used with various recommendation models to determine specific seed, nutrient, or pesticide needs for different areas of a field. Linked with global positioning satellites (GPS) technology, GIS is used to apply variable rates of seed, fertilizer, and pesticides. GIS/GPS technologies are also used for field scouting, crop records, and continuous on-the-go yield mapping.

6. Calculation of fertilizer/chemical needs—Crop information overlaid on soil maps with soil test data, makes it possible to predict the amount of fertilizer or pesticide needed for a specific geographic area. A dealer can determine the amount to order for a trade area. A farmer could accurately calculate the precise N, P, or K needed on a field or assess the costs of direct herbicides based on various rates needed for a given field.

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Student Supplement 4A—GPS For Agriculture: An Introduction to Differential Concepts

The following article was written by Ted Macy, Applications Mapping Inc., and was printed in the Conservation Technology Information Center's monthly newsletter, Conservation Impact, October, 1994.

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The U.S. Department of Defense has implemented a network of satellites that are designed to help ground based units determine their current location in latitude and longitude coordinates. This system is referred to as a Global Positioning System (GPS), and is available anywhere in the world.

To obtain your position from global positioning satellites, you can purchase a civilian receiver. This receiver is designed to obtain positioning information from several satellites simultaneously, and perform the calculations necessary to determine your current location. There is no user fee or license required to operate a civilian GPS receiver.

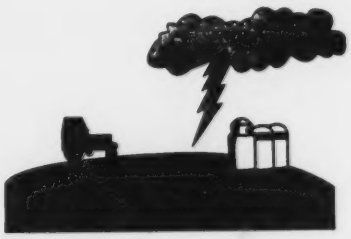
Satellites

Television satellites are in a stationary orbit, and can always be found at the same altitude and azimuth. GPS satellites rotate the earth twice each 24 hours. Therefore, their location relative to a given ground point is constantly changing and the satellites that are in view of the GPS receiver are constantly changing. Two-dimensional coverage requires three satellites to be in view. Two-dimensional means that you can determine your latitude and longitude from the satellites. You must determine your altitude in a different manner. Altitude doesn't normally change much in a ground based agricultural environment.

If at least four satellites are visible, it is possible to obtain three-dimensional cover. That is, your GPS receiver can also determine your altitude.

How it works

GPS receivers can determine their position by calculating the time it takes for radio waves from the satellites to get to the receiver. How? Think about the following example: When you were young, you were likely taught that to tell how far away lightning was when it struck, count the number of seconds between seeing the flash, and hearing the thunder.



You were probably told that counting to five meant the lightning was a mile away. In reality, what you were doing was multiplying the time it took for sound to travel to you, by the speed that sound travels (approximately 880 feet per second). So unless you counted a little slow, a five second delay for the sound really meant that the lightning was 4,400 feet away (less than a mile which is 5,280 feet). So, given that you can calculate distances by measuring the time between knowing and an event happened by one manner (seeing lightning), and knowing it by a different manner (hearing thunder), you can always determine your

distance from the event. This still isn't the whole story yet.

Location example

How do you determine location? Another example: You find yourself lost in the Grand Canyon. You pull out your cellular phone and call a ranger station that is in a fire tower you know about on the east rim. You ask the ranger to fire a gun so you can hear it over the cellular phone (virtually instantly), and can hear it a few seconds later as the sound travels through the air. You use the stop watch built into your wrist watch and time how long it is between hearing the shot over the phone, and through the air. Multiply the time delay by the speed of the sound, and you know how far you are from the ranger's tower. You take your map, and draw a circle around the ranger's tower at that distance.

Now repeat the process for a second ranger's tower on the north rim of the canyon. After drawing the second circle, the circles should intersect at two points. If one of those points is in the canyon, that must be your location. If they are both in the canyon, you would have to call a third ranger's station and repeat the process to determine which was your true location.

Obviously GPS receivers aren't listening for gunshots from satellites. But in reality, they are listening for electronic gunshots. Radio waves seem to travel instantaneously to us, but they actually do have a measurable speed (186,000 miles per second). The GPS receivers have clocks that are so precise that they can effectively measure the time it takes for a satellite broadcast to arrive. The satellite broadcast includes information about the precise location of the satellite (where the ranger stations are). The GPS receiver performs the calculations to determine its actual position (drawing circles on the map).

In its purest and simplest form then, to know the position of a tractor within a field, all that is required is to have a GPS receiver in the tractor, and three satellites visible. Figure 1 is an illustration of this ideal situation (with the third satellite missing for clarity). Operating in this mode, the GPS receiver

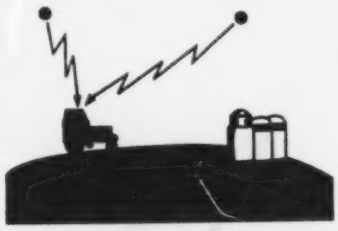


Figure 1. Accuracies within 50 feet - third satellite not shown

can give you a position with about 50 feet of accuracy. That is, if you drove to a location and set a flag, you could probably drive back within 50 feet, and almost always within 100 feet. This is fairly acceptable for a lot of agricultural operations.

Distortion

The preceding examples and the illustration are fairly simplistic. In real life, things always get a little more complicated. For example: The Department of Defense reserved the right to distort the GPS signals in times of military stress. This distortion is known as Selective Availability (SA). The selective implies that military receivers are not affected, but civilian receivers are. The net effect of this distortion is that accuracies are reduced to as poor as 400 feet. This implies a worse case scenario in the "set a flag" example of 800 feet of error. This is generally not acceptable for agriculture.

Determining the differential

However, there is a way to get around the problem. The distortion introduced will affect all receivers in a given geographic area (a few hundred miles) the same way. In Figure 2, we have mounted a GPS receiver on a silo at the farmstead. Since this receiver is stationary and aware of its own location, it can help calculate the difference in the readings it receives from the distorted location signals sent by the satellites. In other words, it can then determine the magnitude of introduced error (the differential).

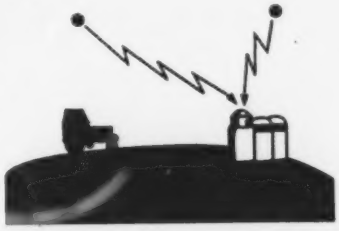


Figure 2. GPS mounted on silo

Differential corrections

In Figure 3, we can add a ground based radio link to send the differential corrections from the silo out to the tractor (the differential broadcast), and the tractor's receiver can apply those corrections to the position that it is calculating from the satellites. This is similar to sending computer data over a phone modem. As a side benefit to this process, we not only take out the introduced error, but we can even improve the performance of the basic positioning.

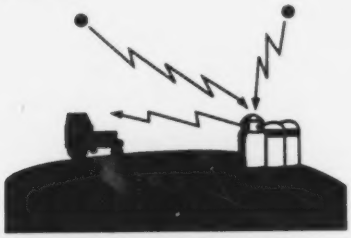


Figure 3. Ground-based radio link added

In Figure 4, if everything is working, it is reasonable to expect accuracies within 10 feet (3 meters). The industry is coming together and there are now some integrated packages entering the market that make most of the differential process accessible to the end user.

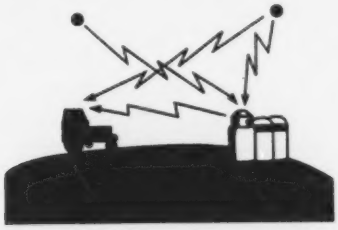


Figure 4. Accuracies within ten feet

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Assignment Sheet 1A—Determine Fertilizer Composition and Rates

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Answers are correct	_____
• Assignment was completed on time	_____

Introduction: Commercial fertilizers come in a variety of strengths and blends. This exercise will test your ability to determine the percentages of plant nutrients in a number of different fertilizer blends.

Directions: After reviewing Student Supplement 1A, answer the following questions concerning fertilizer composition and rates.

1. Identify and record the proper percentages of plant nutrients in the following fertilizer blends.

   a. 18-46-0 _____

   _____

   b. 33-0-0 _____

   _____

   c. 35-10-11 _____

   _____

   d. 0-0-24 _____

   _____

   e. 10-20-10 _____

   _____

2. Determine the number of pounds of the given plant nutrient in 2000 lbs. of the following fertilizer blends.

   a. 15-30-15 (Phosphorus) _____ lbs.

   b. 82-0-0 (Nitrogen) _____ lbs.

Assignment Sheet 1A

c. 17-17-17 (Sulfur) _____ lbs.

d. 5-10-5 (Potassium) _____ lbs.

e. 18-46-0 (Potassium) _____ lbs.

3. Read the following scenarios and answer accordingly.

   a. A soil test shows you need only nitrogen at the rate of 100 lbs. per acre to maintain the grass on a one-half acre park you are maintaining. If the only fertilizer you have is a 5-10-5 blend, how many lbs. of fertilizer will you need to apply to the park to achieve the 100 lbs. per acre rate of nitrogen?

   _____

   b. If you could use ammonium nitrate (33-0-0), how many lbs. of fertilizer will you have to use to apply 100 lbs. per acre to the park?

   _____

   c. If ammonium nitrate cost $200 per ton (2,000 lbs.), how much would your fertilizer application cost?

   _____

   d. If you used the 5-10-5 blend and it cost $7 per 50 lb. sack, how much would your fertilizer application cost?

   _____

   e. How much could you save by using ammonium nitrate instead of the 5-10-5 blend?

   _____

4. If you were paying for the fertilizer application in question 3, which fertilizer would you use? Why?

   _____

   _____

   _____

5. A midwest corn grower wants to plant a 100 acre field. A soil sample analysis from a reputable soil testing laboratory indicates she needs 100 lbs. of actual nitrogen per acre and no additional phosphorus or potassium for optimum corn production. Based on the following fertilizers available to her, which would represent the most cost-effective choice if application costs are all equal?

   a. 18-46-0 at $150 per ton

   b. 33-0-0 at $200 per ton

   c. 82-0-0 at $250 per ton

Assignment Sheet 1A

6. Why do you think farmers would be unwise to fertilize by guessing at application rates versus spending $6 to $12 on a calibrated soil test to determine recommended rates?

_____

_____

_____

7. As spring gets underway and lawns begin to green up, a homeowner sees an advertisement from a lawn and garden store featuring 40 lb. sacks of 5-10-5 lawn fertilizer for $4.00 each. The local feed dealer is not having a sale, but sells 10-20-10 fertilizer everyday for $6 per 50 lb. sack. Assuming the homeowner's lawn needs a total of 20 lbs. of actual nitrogen and can use the P and K in each of the blends, which is the best buy? Why?

_____

_____

_____

8. If a Missouri rancher has access to chicken litter (manure and bedding) which contains 5 percent nitrogen and he applies this litter to pastures at the rate of 2 tons per acre, how much actual nitrogen per acre would he have placed on his pastures?

_____

9. A soil sample shows your front lawn needs nitrogen at the rate of 50 lbs. per acre to sustain bermudagrass growth through the summer. Assuming your lawn is one-tenth of an acre, how much 10-20-10 fertilizer would it take to provide the recommended amount of nitrogen?

_____

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Assignment Sheet 2A—Report on GIS/GPS Technology and Utilization

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Report shows grasp of subject and appropriate research effort	_____
• Report is neat and legible	_____

Introduction: With affordable satellite mapping and location technology available to individuals, business, and government agencies, several states are actively building Geographic Information Systems (GIS) which, with satellite Global Positioning Systems (GPS) can be used to help map development, protect sensitive environmental areas, and irrigate and fertilize farm fields almost on a custom basis according to soil type and slope. Although not yet widespread, GIS/GPS technology is rapidly spreading into construction, recreation, land use planning, farming, and law enforcement. This assignment will allow you to consult your local library or on-line computer service to research recent activities in these areas.

Directions: Using information from at least five current (within the last two years) periodicals, or essays found on on-line computer services such as CompuServe, America On Line, or the Internet, write a report detailing how GIS information can be used in a positive manner in one or more of the industries or agencies listed in the introduction. Also, using what you learn about GIS/GPS in your research, write a short essay on possible conflicts from the use of GIS/GPS technology and private property rights.

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Job Sheet 1A—Determine Suitability of a Site for a Septic System

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation criteria	Rating
• Directions were followed	_____
• Holes dug to proper depth	_____
• Soils collected and identified as holes are dug	_____
• Measurements correct and taken in a systematic manner	_____
• Report is neat and legible	_____

Directions: When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the above criteria.

A. Equipment and materials

- At least 8 yardsticks
- Auger-type post hole digger (powered or manual)

  Note: Use proper safety handling techniques for power tool operation. See your instructor for proper use techniques.

- At least 8 plastic sacks or sheets of plastic construction film
- Water buckets and water source or garden hose
- Notebook and pencil or pen

B. Procedure

☐ 1. On the site to be tested, determine at least eight locations in which to dig holes 24 inches deep.

☐ 2. Using an auger-type post hole digger, begin removing soil from the locations, keeping the soil laid out near the hole in the order in which it was removed. Place the soil on plastic sheets for inspection and ultimate replacement in the holes.

☐ 3. Continue digging until the holes are 24 inches deep. Note and record the change in soil type and color from the surface to the bottom of each hole.

Job Sheet 1A

☐ 4. Install a measuring device such as a yardstick in each hole and fill the hole with water. Mark the level of the water at this point.

☐ 5. At one-hour intervals note and record the water level of each hole.

☐ 6. Continue throughout the day, and recheck the holes the following day. Using records from direct observation, and extrapolated measurements from the number of hours you are away from the site for any holes still containing water the following day, determine the average time each hole requires for a 1-inch drop in water level.

☐ 7. Using the figures in Student Supplement 2A from the U.S. Health Department, rate this site for its suitability for a septic system in a written report. Also describe the types of soils found at this site and how they affect the site's percolation characteristics. Turn assignment in to instructor.

☐ 8. Refill each of the holes with the soil removed from them, taking precautions to place the last soil removed back in the hole first to replace the soil horizon in the order in which it came from the hole.

☐ 9. Clean the work area and tools.

Evaluator's comments: _____

_____

_____

_____

Air Resource Management
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Unit 5

Student Supplement 1A—Understanding the Weather

(Adapted from *Working With Weather, Successful Farming*, 1994)

Understanding the weather has been a challenge for humans throughout history, and even with today's sophisticated computers and satellite monitoring systems, truly accurate forecasts of climatological activities remain rare.

Although there is a wide variety of factors that cause weather, this supplement will deal only with the "weather makers" most people see and hear about every day. (For more information on the fascinating subject of weather see the list of recommended books at the end of this supplement.)

Air Masses and Fronts

The earth's atmosphere is not merely a quiet layer of breathable air from sea level to the upper reaches of the stratosphere. In actuality the atmosphere is a pitching, churning "sea" of air kept turbulent by large masses of air called high pressure systems. A high pressure system is literally a mound of air which exerts pressure on the earth and its inhabitants below.

The "weight" of a high pressure system, and the air around it, can be measured with an instrument called a barometer. As a high pressure system approaches, the barometer responds with "higher" readings. Barometric readings are quoted in terms of "inches of mercury," relating to the construction of many barometers which measure air pressure by its effect on a column of mercury trapped in a glass tube. More common barometers (those which look like auto or aircraft instruments) are called "aneroid barometers" and use a hermetically sealed bellows with which to measure air pressure.

As high pressure systems move about, driven by the earth's surface temperatures and upper level winds created at their border with lower pressure areas, they become the driving force behind one of the most common terms used by weather forecasters—the front.

While air masses share the same background, they can be either warm or cold depending upon where they were created.

Cold air masses that affect North America often develop over Alaska and northwest Canada and usually drift south and east along the eastern slopes of the Rocky Mountains. This type of air mass has a tendency to be dry, unless it slips out over the Pacific Ocean where it picks up moisture before drifting eastward across the Americas. As this cold air mass travels south over warmer terrain, it tends to heat up which increases its ability to hold moisture. The tiny particles of moisture (thousands of times smaller than a rain drop) divide into even smaller particles as the air around them warms. This, plus the fact that cold air masses contain less moisture, is why these "systems" are less likely to cause precipitation.

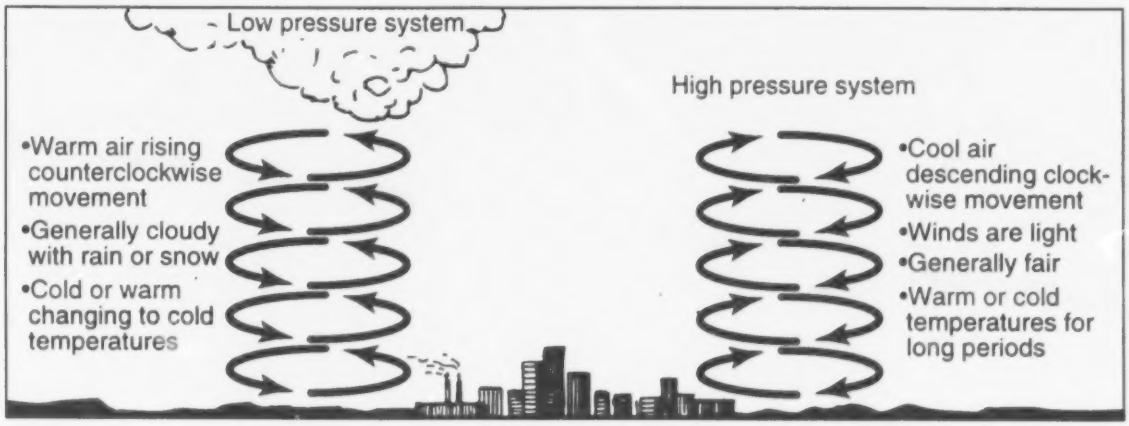
Warm air masses, however, generally develop off the eastern coast of Florida and move across the Gulf of Mexico, soaking up moisture, before they push northward onto the North American Continent and drift eastward. When this occurs the warm air mass is moving over terrain that is colder than itself. This causes the moisture in the mass to condense, increasing the chances of it producing precipitation.

Student Supplement 1A

As long as these two systems move along and never meet, the weather picture is quite boring. When they collide, however, unstable conditions occur.

Cold and warm air, like oil and water, don't readily mix. When they meet they push against one another in an effort to move ahead. Often the cold air mass, which contains more weight (literally the weight of the air piled up in the mass) or internal pressure, wins by ducking under the edge of the warm air which is then pushed upward.

Because both cold and warm air masses are high pressure systems, they rotate in a clockwise direction when viewed from the top. (In the southern hemisphere, however, they operate counterclockwise.) When two highs, both spinning in the same direction, approach one another they create a vacuum-like effect between them. This spawns a low pressure system or "cell." The air in a low-pressure cell is spun in the opposite direction—counterclockwise (in the Northern hemisphere) by the trailing edge of one high and the leading edge of the other.


Low pressure system
High pressure system
•Warm air rising counterclockwise movement
•Generally cloudy with rain or snow
•Cold or warm changing to cold temperatures
•Cool air descending clockwise movement
•Winds are light
•Generally fair
•Warm or cold temperatures for long periods

You recall in a high pressure system the water droplets are forced downward and are dispersed. The opposite is true in a low-pressure cell. Here it rises and cools. This causes the tiny particles of moisture to condense and eventually grow large enough to overcome the force of internal winds and gravity and fall to earth. So, "lows" on the weather map are depicted on the weather map as more likely to produce precipitation.

All the pushing and shoving between air masses, and the low-pressure cells they create, also spawns a weather boundary called a front. As you might guess, cold and warm air masses create cold or warm fronts.

Student Supplement 1A

Cold fronts are represented on a weather map as a curved line with arrowhead-shaped marks on them.

The arrowheads point in the direction the front is moving. Cold fronts usually move at speeds of 20 to 30 miles per hour. When accompanied by moist air and certain other conditions, cold fronts can cause brief but fairly violent storms. However, cold fronts tend to carry less moisture than warm fronts so they are less likely to drop a great deal of precipitation. In the Northern hemisphere if a cold front is bringing rain or snow, it will be preceded by clouds and increased southerly wind velocity.

Warm fronts are shown on weather maps by lines with rounded, bump-like marks on them, also pointing in the direction of their movement.

Warm fronts usually don't have as much curve to them as their colder counterparts on the weather map. Also they are slowpokes, normally moving about 10 to 15 mph.

Storms growing out of warm fronts tend to be less violent than those from cold fronts. But warm fronts usually pack far more precipitation. That's because the warm air behind them likely formed over the ocean where it absorbed much moisture before moving landward. As warm fronts cool while crossing land they become less stable.

One of the major problems with weather predictions is that fronts, either warm or cold, are anything but dependable. At times they move along at a steady, typical speed only to suddenly shift directions and speeds. At other times they opt to stall out and remain in one place for hours or days. When this happens the movement is labeled a stationary front, represented on a weather map by a mixture of arrows and bumps on a line.

Student Supplement 1A

Although we cannot see the dividing lines of warm or cold fronts, the presence of clouds gives us a very accurate picture of the location of these air masses.

Clouds and Moisture

If you have ever walked in fog, you have walked in a cloud. Fog is nothing more than a cloud on the ground.

Clouds are created from masses of tiny water, snow, or ice crystals suspended in the air. Still the amount of moisture in even a giant summer thunderhead is small. For example, all the water in a towering thunderhead would fill only two or three swimming pools. And one of those fluffy white summer afternoon clouds holds less moisture than a livestock water tank and weighs about as much as a human.

Clouds are light because they are made up of water vapor. Actually we are surrounded by moisture vapor—suspended water one cannot see until it rises in the sky to cool and condense or in your breath on a cold winter day.

As it rises, air expands and cools. And as it expands, the water in the air condenses into minuscule droplets one millionth the size of a rain drop. When enough droplets gather, they form a cloud. The point in the sky where moisture condenses is called the "condensation level" and is easily seen as the flat bottom of a puffy cloud.

Depending upon conditions, nature can form three basic types of clouds—cirrus, cumulus, and stratus. Let's describe them, and their variations from highest to lowest.

- **Cirrus**—These clouds wander at the rooftop of the sky. They are thin, wispy, and feathery formations made up entirely of ice crystals, usually found from 25,000 feet above the earth to more than 10 miles up. Cirrus clouds, driven by upper level winds, generally move around 65 to 75 mph, but appear much slower because of their extreme altitude.

- **Cirrostratus**—These clouds form from 20,000 to 25,000 feet above the earth and look like a fine, whitish veil that extends over all or part of the sky. The sun is easily visible through cirrostratus formations which often produce halos around the sun or moon.

- **Altostratus**—These clouds are formless, grayish groups of water droplets that cover part or all of the sky in a great sheet. They often appear fibrous or stripped and do not form a halo around the sun or moon. In the daytime, however, one can always see the sun through altostratus clouds.

- **Altocumulus**—These clouds are patches or layers of puffy and rippled clouds that are gray or white. The sun shining through altocumulus clouds can create a corona or disk and is pale blue or yellow in the middle and reddish on the outside. Neither altostratus or altocumulus clouds drop precipitation that reaches the ground.

Student Supplement 1A

Rain-producing clouds are found floating from 6,500 feet above the earth to the surface. They include:

- **Stratus**—These formations float at about 6,500 feet or less and are thick, gray, dull sheets covering the entire sky—completely blocking the sun. Usually stratus clouds produce little more than a fine drizzle.

- **Nimbostratus**—These clouds are dark gray with moisture and completely blanket the sky. They have little structure such as puffs or ripples and can produce rain or snow that lasts for a day or more. When the wind is strong enough, nimbostratus sheets are often teamed up with low lying individual clouds called "scud" or "fractostratus" clouds.

- **Stratocumulus**—These clouds cover the sky but are irregular masses of moisture spread out in a bumpy or rolling layer. Again, these thick clouds block out the sun, but rarely produce rain unless they mass together to form a nimbostratus blanket.

- **Cumulus**—These clouds and the cumulonimbus are the only two cloud types that form vertically. Both appear predominately in warmer weather. Cumulus clouds are the most common type of cloud seen on summer days. White and puffy, these clouds show a sharp border above and below and are often torn by strong winds with detached parts constantly changing shapes. Cumulus clouds are formed by condensation of water vapor in a rising column of air. The flat base of a cumulus cloud marks the level where the condensation temperature is reached. Cumulus clouds rarely produce rain unless they gather together.

- **Cumulonimbus**—These are the towering monsters of spring, summer, and fall known as thunderheads. The flat bottom of a cumulonimbus can almost touch the ground while their tops—which often form into anvil shapes as they mature—can reach as high as 75,000 feet. Cumulonimbus clouds are the most violent, producing lightning, thunder, hail, strong straight winds, and tornadoes.

Any of these cloud formations can exist alone or in combination with others. They also can change from one type to another when variations in temperatures or moisture occur. And, changing clouds indicate the weather is also about to change.

Precipitation and Humidity

When the tiny droplets of water in clouds—particularly those found closer to the earth—congregate closely, precipitation is born. The most common form of precipitation is rain.

There are three ways these droplets can combine and drop to earth. When air in a cloud becomes turbulent, movement of the droplets increases. Smaller droplets bump into larger, slower droplets until a drop of sufficient size is formed and pulled down by gravity.

At higher altitudes, some of these droplets freeze into ice crystals. Other droplets evaporate and adhere to these crystals until the crystals become heavy enough to fall. If temperatures are warm, these crystals melt and fall as rain. This is believed to be the most prevalent way in which rain drops form.

Or, during a thunderstorm, discharges of lightning emit oxides of nitrogen which readily absorb moisture forming raindrops large enough to fall to the ground.

Student Supplement 1A

Rain isn't the only moisture that falls from the sky, however.

When the air is supersaturated with water and is below the freezing point, snowflakes can form. But instead of moisture bumping together, as it does for raindrops, flakes are created around microscopic particles of dust, sand, or ash found in the air. Ideal cloud temperatures for snowflake formation are from 10 degrees F. to –4 degrees F.

Sleet or ice pellets occur when raindrops form at warmer temperatures aloft and freeze as they fall through cold surface temperatures.

Hail is created when raindrops are frozen at high altitudes and then bounced around, adhering to others, in a thunderhead until they become heavy enough to fall.

Dew and frost occur when moisture condenses on the ground and on nearby objects. This happens because these surfaces are colder than the moisture in the air. A good example of dew is the moisture that forms on a cold glass of iced tea on a summer day.

The difference between these two forms of precipitation is the moisture in frost changes directly to crystals without first condensing into water drops.

Anyone who has suffered through a still, sultry, summer night without air conditioning is aware we can feel moisture that is not falling out of the sky. This type of water vapor is humidity.

The relative humidity so frequently mentioned by TV weather forecasters is the percent of moisture air can hold at a particular temperature. When air with a given amount of vapor cools, its relative humidity increases. When the air is warmed its relative humidity drops. Air can be so loaded with water vapor that it becomes saturated. When this happens the air's relative humidity is 100 percent and it has reached the dew point—the point at which the vapor condenses and becomes some form of precipitation.

Wind

All of the heating and cooling that occurs with weather creates the refreshing breath of air on a summer day or the icy, bone-chilling blast in the winter—the wind.

Wind exists because of the action of heated air rising into the sky and cooler air rushing in to replace it. When this occurs on a massive scale, wind is created. Because it is driven by heating, winds tend to "die down" at sunset.

Because water and land tend to heat and cool at different rates, the air circulation above them differs. This adds to the variability of winds, as do other factors.

The effects of warm air being replaced by colder air extends from the polar regions to the equator. If the earth were not rotating, the winds created by this activity—called convection currents—would be from north to south in the Northern hemisphere. However, since the earth is spinning to the east at about 700 mph at the 45th parallel (the Chicago area) the convection currents end up flowing primarily from west to east.

High- and low-pressure air masses also produce winds. Highs tend to push air toward lows. The closer the masses are to one another, the stronger the winds.

Student Supplement 1A

The strongest winds occur at altitudes of about 35,000 ft., where corridors of wind known as jet streams form. These winds run from 100 to 200 mph in the high altitudes where there is little resistance to their flow. Their paths move generally west to east but develop curves due to pressure differences of air masses along their routes.

Closer to earth, wind velocity is slowed by friction caused by mountains, hills, buildings, and vegetation. This friction tends to heat the air, causing it to rise—creating even more wind.

Recommended Reading on Weather

Most libraries will contain one or more of the following resource texts on weather.

- *Weather*. Paul Leht, Will Burnet, Herbert Zim, Golden Press.
- *The Weather Book*. Jack Williams, Vintage Books.
- *Weather Proverbs*. George D. Freier, Fisher Books.
- *The Old Farmer's Almanac Book of Weather Lore*. Edward F. Dolan, Yankee Books.
- *The Basic Essentials of Weather Forecasting*. Michael Hodgson, ICS Books.
- *Weather and Forecasting*. Storm Dunlop, Francis Wilson, MacMillan Publishing Co..
- *The Weather Wizard's Cloud Books*. Louis D. Rubin Sr., Jim Duncan, Algonquin Books of Chapel Hill.
- *Exploring the Sky By Day*. Terence Dickinson, Camden House.

Cloud Charts and Posters

- U.S. Government Printing Office, Washington, D.C. 20402 (Ask for Cloud Code Chart).
- Cloud Chart Inc., P.O. Box 21298, Charleston, SC 29413-1298
- Sky Guide, P.O. Box 30027, Greenwood Station, Seattle, WA 98103-0027

Weather Instruments

- Davis Instruments, 3465 Diablo Ave., Haward, CA 94545, (800) 678-3669
- Hinds Instruments Inc., 5250 NE Elam Young Pkwy., Hillsboro, OR 97124-6463, (503) 648-1355
- Edmund Scientific Co., 101 E. Gloucester Pike, Barrington, NJ 08007-1380, (609) 573-6250
- Wind & Weather, The Albion Street Water Tower, P.O. Box 2320, Mendocino, CA 95460, (800) 922-9463

Air Resource Management
Advanced Applications
Unit 5

Student Supplement 2A—Forecasting the Weather

(Adapted from *Working With Weather, Successful Farming*, 1994)

Forecasting the weather is an "iffy" proposition even if you have a degree in meteorology and are equipped with the latest electronic equipment, banks of computers, and access to satellite remote sensing. Still, with knowledge of the weather makers explained in Student Supplement 1A and a few of the following basic weather tools, it is surprising how accurate one can be by just observing cloud formations, wind direction, and barometric pressure trends.

In fact, this method was used in one elementary school as a 6th grade class science project. The results, the 6th graders were about 85 percent accurate in their 12-48 hour forecasts!

Tools you need:

Note: The following specialized weather monitoring tools can be obtained at hardware stores or through a number of specialty catalogs. See Student Supplement 1A.

- **Barometer**—A good quality barometer is an absolute must to formulate weather forecasts. Look for an aneroid barometer, because they are more compact and much more accurate than the mercury column variety. Don't be misled or impressed by barometers which sport such words as "Fair," "Stormy," or "Changing Weather" on the face of their dials. These phrases are generally meaningless. What is more important are the pressure readings listed on the instrument's face, and the ability to set the barometer for one's community elevation above sea level.

- **Thermometer**—Most simple mercury thermometers will do a good job. However, a "maximum/minimum" thermometer that uses two tubes to register how high and low the temperature traveled during a period of time is a greater value for keeping weather records.

- **Rain gauge**—Any rain gauge, provided it is emptied on a regular basis and kept clean, is adequate for normal use. More expensive models have greater capacity and many times are calibrated for more accuracy. For snow, just use a ruler stuck in a flat area of snowfall not affected by the wind.

- **Wind vane**—A moist finger stuck in the air provides a quick way to determine wind direction, but it helps to invest in a vane for better accuracy. Also consider an **anemometer** to measure wind velocity. Both instruments (many times built together for common mounting) should be mounted in an area where wind flows are not affected by buildings or trees.

Finally, it helps to record your observations and measurements for future reference. A weather log can be found in Assignment Sheet 3A in this advanced applications supplement.

Student Supplement 2A

Observing and Forecasting

Clouds

While weather instruments provide good insight to changing conditions, personal observation of outdoor conditions is surprisingly accurate also.

By watching clouds, one gets the first glimpse of change.

Cirrus clouds—the highest of all formations—foretell changing weather a day or days before it occurs. Simple cirrus clouds usually mean fair weather in store, but if they tend to thicken and the wind is out of the east or south in summer or the south in winter, they can foretell rain or snow. Cirrostratus clouds predict generally fair weather, especially if they break into cirrocumulus clouds. But, cirrocumulus clouds that begin to thicken and fall lower to the earth indicate the change of rain.

Alto clouds—The advent of altocumulus formations can predict rain, especially if the circle (corona) around the sun decreases and if the winds are from the north or south in summer. However, warmer weather lies ahead in winter if the winds are from the north, east, and south. Altostratus clouds often precede storms if the clouds darken toward the west.

Stratus clouds, by themselves indicate fair weather ahead, especially if they get smaller and break apart. However stratocumulus clouds are a sure sign the weather is changing, particularly if winds are from the north or south in the summer; or north, east, and south in the winter. Finally, nimbostratus clouds indicate a long period of rain that will only turn clear with wind movement in summer.

Cumulus clouds, those puffy summer afternoon clouds, are a sure sign of fair weather—unless they start gathering together. If this occurs on a massive scale, such as with vertical building of a cumulonimbus cloud, then brace for the worst as the weather is changing for the worse.

Clouds moving faster across the sky point to a change in wind velocity and in barometric pressure. Both situations can signal an approaching storm. Also, when several layers of clouds are moving in different directions at different altitudes storms could be imminent.

Reading Pressure and Wind

Once you have a good handle on reading cloud formations, fine-tune those predictions by combining your observations with barometric pressure readings and wind speed and direction. All three elements, used in conjunction with a current weather map and area forecast, creates amazingly accurate predictions for a 12 to 48 hour period.

To bring pressure readings and wind directions together for forecasting, see the forecast guide at the end of this supplement.

Student Supplement 2A

Some Forecasting Rules of Thumb

In his book, *The Basic Essentials of Weather Forecasting*, Michael Hodgson adapted the following material gathered by the National Weather Service for average conditions within the Continental U.S.

When winds are from the northwest and the weather has been clear, expect 24 hours of continued clear weather if your barometer is steady or rising. If it has been raining and you read a rise in barometric pressure, weather should clear in several hours. In all of these cases expect lower temperatures.

If your barometer shows a drop in pressure, expect it to remain clear for 12 to 24 hours if it has been clear, or expect the weather to change if it has been stormy.

When winds are from the southwest and weather has been clear, anticipate continued fair weather for 12 to 24 hours if the barometer shows a rise in pressure. If it has been stormy and you read a rise in pressure, then the storm should pass within six hours.

When weather has been clear and winds are from the southeast, plan on continued fair weather if the barometer is rising. If the weather has been stormy, anticipate clearing weather soon after the barometer begins to show a rise in air pressure.

When winds are in the northeast and the weather is clear, expect continued fair, but cool weather if the barometer shows a rise in pressure. If the weather has been stormy, expect skies to clear and temperatures to drop.

Finally, there are a number of general signs indicating the advent of either fair or foul weather that you can use as a reference in the field.

Fair weather signs:

- Dew or frost in the night or early morning
- Morning fog that burns off by noon
- A red sunset in a blue sky (Red at night, sailors delight)
- A brilliant moon on a clear day
- A clear night sky with light winds

Foul weather signs:

- Any rapid rise or drop in temperature
- A ring around the moon, especially if the barometer is dropping
- A rusty, red hue around the sunrise (Red in the morning, sailors take warning)
- The rapid approach of a warm or cold front as indicated by a weather forecast

Student Supplement 2A

Barometric Pressure and Wind Forecast Chart

Barometer Reading (corrected)	Barometer Action	Wind Direction From the:			
		Northwest	**Southwest**	**Southeast**	**Northeast**
30.20	Rising	Continued fair for 24 hours Lower temperatures	Continued fair for 12 hours	Fair weather	Clear and cool
or	Steady	Continued fair for 48 hours No decided change in temperature	Continued fair for 12 hours No decided change in temperature	Rain within 24 to 48 hours	Continued fair Lower temperatures
Higher	Falling	Continued fair for 24 hours Slowly rising temperatures	Fair for 6 to 12 hours Rising temperatures	Rain within 2 hours Wind increasing in force, rising temperatures	Rain within 24 to 48 hours
30.20	Rising	Fair for 48 hours Lower temperatures	Fair for 48 hours Lower temperatures	Fair	Clear with colder weather
to	Steady	Continued rainy conditions	Fair for 12 hours No decided change in temperatures	Rain within 12 to 18 hours	No change
29.80	Falling	Fair for 12 to 24 hours No decided change in temperature	Rain imminent	Rain within 6 to 12 hours Wind increasing in force, rising temperatures	Rain within 12 hours
29.80	Rising	Clearing within a few hours Lower temperatures	Clearing within 6 hours	Clearing weather	Clearing and cooler
or	Steady	Continued threatening weather Lower temperatures	Continued stormy weather	Continued rain or no change	Rainy weather Clearing 12 to 24 hours
Lower	Falling	Changing weather	Increasing rain Clearing within 12 hours	Severe storm imminent Clearing within 24 hours	Heavy rain Severe northeast gale, cooler temperatures

To use this weather chart you need to obtain a barometer reading corrected to sea level, determine the action of the barometer (rising, falling, steady), and gauge the average wind direction (the chart is set for an average wind velocity of 10 miles per hour). For example, take a barometer reading that measures between 30.20 to 29.80. If that reading is rising and the wind is coming from the northwest, you can assume that it will be fair for the next 48 hours with temperatures dropping. Higher wind speeds and rapidly rising or falling barometer readings often indicate an immediate change in weather. Fine-tune this prediction with observations of cloud activity and official forecasts to obtain an even more accurate picture of weather over your vicinity.

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Air Resource Management
Advanced Applications
Unit 5

Assignment Sheet 1A—Collect and Report Results From Air Monitoring Equipment

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Report reflects cognitive grasp of subject	_____
• Test results are interpreted correctly	_____
• Report is neat and legible	_____
• Report was completed on time	_____

Introduction: In Assignment 3 you collected particulate matter using petroleum jelly pads. This activity will give you an opportunity to observe air quality tests being performed by a state health department technician using air monitoring equipment.

Directions: Observe the procedure used in testing air quality with air monitoring equipment, then collect and report test results. The report should be no more than two pages and include the following:

- Equipment used to test air quality
- Tests that were performed
- Description of operational procedure for tests
- Results of tests
- Interpretation of test results

Note: If time allows, compare these test results with the results reported in Assignment Sheet 3, and discuss possible sources of the air pollutants identified using air monitoring equipment.

Air Resource Management
Advanced Applications
Unit 5

Assignment Sheet 2A—Investigate the Contribution of Methane Gas To Global Warming

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Report is thoroughly researched and documented	_____
• Conclusions are based on research findings	_____
• Solution or reason to do nothing is logical	_____
• Future outlook is logical	_____
• Report is neat and legible	_____
• Report was completed on time	_____

Introduction: As the scientific community has theorized the concept of global warming due to an increase in so-called "greenhouse" gases, many research projects have been launched to study the various "causes" of such gases in the atmosphere. One of the compounds drawing the interest of some researchers is methane—the dominant chemical found in common natural gas. Methane also is generated as organic material decays and is a by-product of digestion in mammals. This exercise is designed to familiarize you with the research done on this subject and the conflicting claims of opposing sides of the argument to control greenhouse gases through the reduction of methane in the atmosphere.

Directions: Using at least four of the resources listed below and other available resources such as access to America-On-Line or CompuServe, investigate the contributions of methane gas to global warming and write a report documenting your findings.

Resources

American Petroleum Institute
Public Affairs Department
1220 L. Street, N.W.
Washington, DC 20005

The Environmental Protection Agency
Public Information Center
401 M. Street, S.W.
Washington, DC 20460

Assignment Sheet 2A

U.S. Department of Energy
Attn: Mr. Robert Kane
1000 Independence Avenue, S.W.
FE-4
Washington, DC 20585

Global Climate Coalition
1331 Pennsylvania Avenue, N.W.
Suite 1500, North Lobby
Washington, Dc 20004-1703

Global Warming: What We Know Today
National Coal Association
1130 Seventeenth Street, N.W., Suite 220
Washington, DC 20036

Michaels, Patrick J. "The Science of Politics and Global Change," *International Journal of Environmental Studies*, 1990.

Idso, Sherwood B. *Carbon Dioxide and Global Change: Earth in Transition.* Tempe, AZ: IBR Press, 1989.

Jastrow, Robert, William A. Nierenberg, and Frederick Seitz. *Scientific Perspectives on the Greenhouse Problem.* Washington, DC: George C. Marshall Institute, 1989.

Your report should be two to three pages (not counting the title page) and include the following:

- Title page—title of report, your name, class period, date
- Body of paper to include
  - — Contributions of methane gas to global warming
  - — Conclusions relating to the seriousness of global warming
  - — Possible solutions to the problem or reason why nothing needs to be done
  - — Future outlook
- Bibliography—sources of information used for report

Air Resource Management
Advanced Applications
Unit 5

Assignment Sheet 3A—Maintain a Weather Log for 21 Days

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Log is neat and orderly	_____
• Log is accurate and well documented	_____
• Report reflects cognitive grasp of subject	_____
• Report is neat and legible	_____
• Report was completed on time	_____

Introduction: Looking out the window to see it raining, or to see a bright sunny day, can tell you what the weather is like at the moment you observe it. To get a better idea of what weather trends are like, it's necessary to track weather conditions over a longer period of time. This exercise will give you a 21-day period in which to observe the weather conditions in your area and to compare those observations with professional weather forecast results.

Directions: Using the weather log included in this assignment, keep a daily record of weather conditions at your school or home for 21 consecutive days. Attempt to observe the weather at the same time each day, take readings and take notes. Watch television or listen to radio weather segments each day, or access weather reports on an on-line computer service such as CompuServe or America-On-Line, and take notes on forecasts and current conditions reported by professional meteorologists. Compare your observations with those of broadcasters in a report to be submitted to your instructor.

Your report should be no more than two pages and should detail how your observations coincided with professional weather forecasts on your local television and radio stations or on-line computer service.

Assignment Sheet 3A

Weather Log									
Daily Weather Record									
	Date	Time	Barometric Pressure	Temperature	Relative Humidity	Precipitation (rain/snow)	Wind Direction	Wind Speed	Cloud Conditions
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

Air Resource Management
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Unit 5

Assignment Sheet 4A—Formulate Weather Forecasts

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Student recorded daily weather data accurately	_____
• Student used weather forecast chart accurately when cross-referencing barometric readings and trends with existing wind conditions	_____
• Student presented weather forecast, based on observations, in a clear and concise manner	_____

Introduction: Forecasting the weather is an inexact science, with many variables to cause imprecise predictions. Still, the ability to predict general trends and the general possibility of storms or fair weather is interesting as well as important. This exercise will lead you through the scientific observations needed to formulate a weather forecast that promises to be relatively accurate over a 24 to 48 hour period.

Directions: Using a copy of the weather forecasting chart in Student Supplement 2A, take daily readings of the wind direction, barometer readings and trends, and formulate a weather forecast based on these observations. In addition, take notes describing the cloud conditions you observe and use these observations, along with other weather forecasting information found in Student Supplement 2A to further refine your forecast. Watch local television weather broadcasts, or listen to radio forecasts and compare them with your outlook. If possible, monitor weather maps available in on-line computer services such as Data Transmission Network (DTN), CompuServe, or America-On-Line. Don't change your forecast to match the others if there are discrepancies—you are dealing with relatively reliable forecasting tools. Once you have made the observations and formulate your forecast, present them to the class and discuss your observations and the reasoning behind your forecast—particularly if your outlook doesn't match that of the professionals.

Air Resource Management
Advanced Applications
Unit 5

Assignment Sheet 5A—Analyze Current Reports Concerning Federal Mandates to Combat Air Pollution From Auto Exhaust

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Minimum of five current articles collected	_____
• Directions have been followed	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____
• Report was completed on time	_____

Introduction: Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to air resource management.

Directions: Using books and magazines from your local or school library, and articles found in on-line computer services, clip and save at least five articles dealing with federal mandates that certain cities use reformulated gasoline to combat air pollution from auto exhaust. Seek articles that represent both "pro" and "con" on this subject, and write a report based on the information you find concerning the goals and responsibilities of the Environmental Protection Agency (EPA), the costs and effectiveness of various reformulated gasoline mixtures, and public response to governmental regulations that require the use of these fuels. End your report by drawing your own conclusions on the mandates and their effectiveness and whether the government is justified in its actions.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning federal mandates to combat air pollution from auto exhaust, consult the *Reader's Guide* in your school or community library.

Energy Resources
Advanced Applications
Unit 6

Student Supplement 1A—Anaerobic Decay and Methane Production

If you have ever experienced the "rotten egg" smell of rotting vegetation in the aftermath of a flood, you have witnessed one of the oldest processes of decomposition on earth. The smell that greeted you was traces of hydrogen sulfide produced as anaerobic bacteria (those that thrive without oxygen) consumed plant material and gave off CO_2, methane (CH_4), water, and traces of hydrogen sulfide (H_2S).

Methane, of course is the basic compound found in "natural gas," a clean-burning, relatively non-polluting fuel used for light, heat, internal combustion fuel, boiler fuel, and fertilizer production.

The oldest form of a methane "digester," is the flood pool you may have smelled. Organic matter covered by a pool of warm water will first turn acidic and smell rank, then slowly—over about six months—will turn alkaline. The methane bacteria (always present) will take over and decompose the organic matter in the pond, and gas bubbles will rise to the top.

Given tremendous amounts of animal and plant waste available, and given limited amounts of natural gas and other fossil fuels, the conversion of biomass to useful fuels and other organic solids is a potential asset in a world in need of additional fuel and fertilizer. Operated correctly a methane digester can produce biogas from animal wastes which contains about 70 percent methane.

In fact, the Los Angeles Hyperion sewage treatment plant recovers enough methane from its primary sewage treatment facility to power twenty-four 2,000 hp. diesel engines on site. Throughout the developing world small farm-size digesters produce gas for home heating, agricultural processing, lights, and tractor fuel. In the U.S., however, the potentials of biogas manufacture have scarcely been tapped because other forms of energy have been economically more attractive.

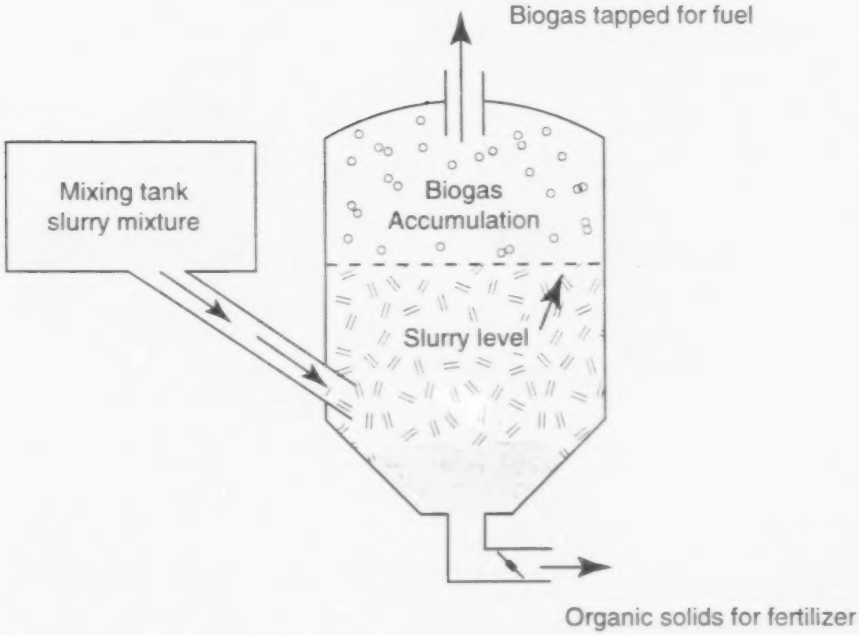
Research has shown a digester operates most efficiently at about 95 degrees Fahrenheit. Methane production does take place as low as 60 degrees F., but at 95 degrees F. the process will yield about twice as much useable fuel in a fraction of the time.

Because methane weighs about half what atmospheric air weighs, one can expect it to rise if liberated. Using that property, digester-produced methane can be trapped by covering a sewage lagoon or digester with some sort of tent-like roof. The gas can then be pumped to a storage facility or compressed into a liquid for transportation. At the same time CO_2 is roughly twice as heavy as atmospheric air, so it will normally try to settle under any methane produced.

Basic methane generator design consists of a closed vessel in which a 50/50 slurry of animal manure and water can be held at roughly 95 degrees F. As the digestion process begins any oxygen in the vessel will be used by aerobic bacteria present. Once oxygen is no longer present, anaerobic bacteria will begin digesting the manure and other wastes—subsequently forming biogas which rises to the top of the vessel. By tapping this gas, one can obtain flammable methane for use as a fuel.

Student Supplement 1A

A cross-section illustration of a basic methane digester might appear as follows:



Energy Resources
Advanced Applications
Unit 6

Student Supplement 2A—Ideas for a Simple Solar Collector

Solar collectors range from simple contraptions built from scrap materials to highly sophisticated, highly-engineered commercial units costing thousands of dollars.

While one usually gets what is paid for, it's not necessary to spend thousands of dollars to make a workable solar collector which will do an outstanding job of heating air with the sun's rays. In fact, using only a minimum of purchased parts, one can make a solar panel that will easily produce 140 to 150 degree Fahrenheit air on a sunny winter afternoon.

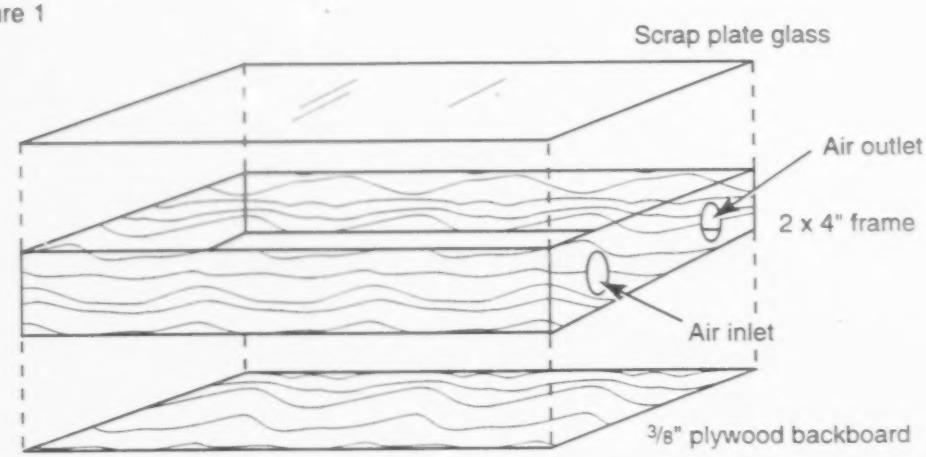
In this supplement you will see a basic air heating solar collector made from 2 × 4 × 8 boards serving as a frame, a sheet of scrap plate glass (obtainable from most glass stores who service insulated patio doors...these sheets of glass are usually permanently stained and not saleable, so you can probably obtain one for free!), a sheet of $\frac{3}{8}$-inch or $\frac{1}{2}$-inch plywood, some empty aluminum soft drink cans, some aluminum flashing (available at any home supply store or lumber yard) a can of black spray paint, some screws, and a tube of high-temperature silicone caulking material. With some flexible ducting and a small blower motor (such as a hair dryer with a "no heat" setting) you can build your version of this heater in an afternoon and be ready to test it the next day!

First, obtain the sheet of tempered plate glass. Most are 48 × 64 inches if they came from sliding patio doors. Others come from storm windows which have broken seals and have cloudy appearances making them unsuitable for windows—but quite useful for class project solar panels!

Using the dimensions of the plate glass, build a 2 × 4 × 8 lumber frame, and cut a piece of plywood the same size as the glass to serve as a backboard for the frame. Attach the backboard to the frame with wood screws.

Cut a 4-inch hole near both edges of one end of the frame (as shown in Figure 1).

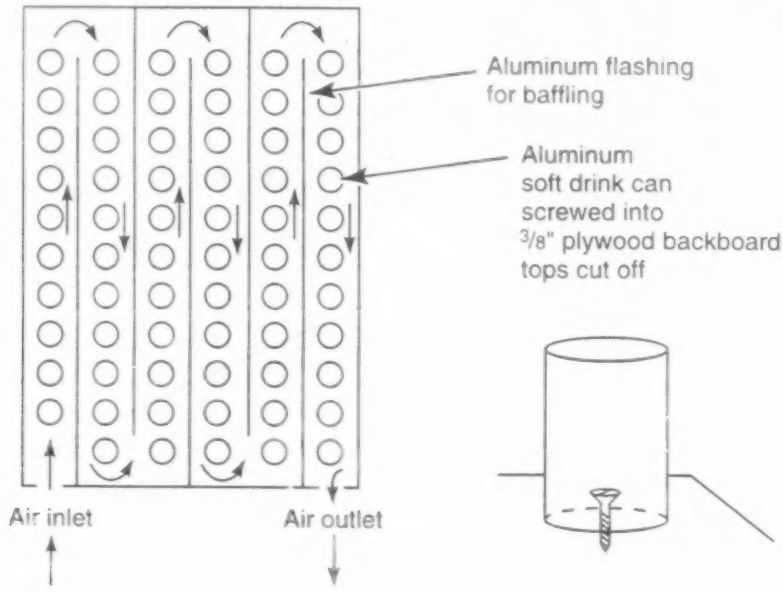
Figure 1



Student Supplement 2A

Then, using enough aluminum soft drink cans (with their tops cut off so they will fit, standing up, between the backboard and the glass when it is glued on top of the frame—attach the cans in rows to the backboard (as shown in Figure 2).

Figure 2


Aluminum flashing for baffling
Aluminum soft drink can screwed into 3/8" plywood backboard with tops cut off
Air inlet
Air outlet

Attach aluminum flashing between the rows of cans in an appropriate manner (bend a lip on the flashing and attach to backboard with screws) to provide a baffled flow of air through the collector.

Spray paint inside of frame, cans, and flashing with flat black paint to enhance solar collection.

Once paint is dry, run a bead of high-temperature silicone caulking (available at most hardware and mass merchandise stores for less than $5) around the top of the frame and carefully place glass over top of frame. Caulking should cure overnight and the solar collector will be ready to use once the glass is secure.

Note: It might be advisable to nail small wooden cleats around the edge of the plate glass to prevent it from sliding one way or another should the caulking fail to hold it to the frame.

Attach flexible ducting to both the inlet and outlet and attach a small flower to the inlet duct.

With the collector positioned to face the sun, one should be able to produce a significantly hotter air at the outlet than the air being drawn into the blower near the inlet.

Energy Resources
Advanced Applications
Unit 6

Assignment Sheet 1A—Analyze Current Reports Concerning Energy Resources

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____

Introduction: As part of your ongoing study of current events as they relate to this unit of instruction, this assignment will allow you to explore the various factions and viewpoints involved with the use of renewable and nonrenewable resources.

Directions: Using books and magazines from your local or school library, and articles found in on-line computer services, clip and save at least five articles dealing with energy resources, their use, their relative abundance, and political and economic controversies surrounding their use and exploitation.

In all cases there will be emotional stands taken on many sides. Using the information you have collected, consider the sides of the controversy and write a report based on your research and personal experience concerning your chosen subject.

Suggestions for reports might include:

1. The true cost of foreign oil to U.S. economy, considering the military expenditures necessary to maintain open sea lanes from the Persian Gulf to U.S. refineries, and the overall balance of trade deficit resulting from importing 50 percent of U.S. petroleum needs.

2. Federally subsidized western water projects for inexpensive hydro-electric power used by desert communities such as Las Vegas.

3. The use of corn-based ethanol as a motor fuel.

4. The controversy over the use of ethanol or MTBE (a petroleum product) in reformulated gasolines.

5. If the U.S. has limited petroleum resources, why then was Alaskan oil being sold to Japan through the 1980s?

6. In 1973 the U.S. oil reserves were estimated to be depleted within 16 years. Why has the U.S. not run out of domestic oil?

Assignment Sheet 1A

7. With about 20 percent of U.S. electrical needs being met by nuclear-powered generation stations, why have only a few nuclear-powered plants been built since the 1970s?

8. Given the dangers of radioactive waste generated by current-technology nuclear fission plants, what is being done to dispose of these growing supplies of spent fuel rods?

9. What is the current status of so-called "breeder reactors," which create more nuclear fuel than they use?

10. How should environmentalists' concerns about displacing top soil and forest land to strip mine coal for power generation be met, given the nation's need for reliable energy sources?

Note: For help in finding recent periodicals concerning controversies surrounding the use of energy resources, consult the *Reader's Guide* in your school or community library.

Energy Resources
Advanced Applications
Unit 6

Job Sheet 1A—Build and Test a Solar Collector

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Solar collector performed adequately	_____
• Worked cooperatively with others to reach a common goal	_____
• Project summary was well-written, showing grasp of project and the operation of a solar collector	_____

Introduction: Solar collectors provide an effective method of storing and transmitting heat. Since solar heating is cleaner and it provides an alternative to other energy resources such as coal and natural gas, researchers will continue to develop more sophisticated systems that are more efficient and economical. In this activity, you still study how a simple solar collector works and compare the air temperatures at the inlet and outlet.

Directions: Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an equal opportunity to contribute to this activity. Then, using Student Supplement 2A as a guide, gather materials and construct a simple hot-air solar collector. (Use your imagination in selecting building materials. The cheaper the better.) Project summaries should be submitted by each team detailing the project and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

A. Equipment and materials

- Student Supplement 2A
- Materials as specified in supplement or identified by team members

B. Procedure

☐ 1. Obtain materials needed to build collector.

☐ 2. Construct solar collector according to team plans or design presented in Student Supplement 2A.

Job Sheet 1A

☐ 3. Test solar collector on a cold, sunny day and compare ambient air temperature with that of the outlet of the collector.

☐ 4. Prepare a two-page summary of the project (as a team), including the following:

- Materials used to construct collector
- Results of the test (difference in air temperature)
- How the collector might be used to lower fuel bills
- Recommendations on how the efficiency of the collector might be improved

Evaluator's comments: _____

_____

_____

_____

Energy Resources
Advanced Applications
Unit 6

Job Sheet 2A—Build and Operate a Methane Generator

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Safety precautions observed	_____
• Worked cooperatively with others to reach a common goal	_____
• Device performs correctly	_____
• Project summary was thorough and well written	_____

Introduction: Although methane production has been limited in the U.S. in its use as an alternative energy source, it serves as a viable replacement for natural gas and other fossil fuels. In this assignment you will study firsthand the process for methane production.

Directions: Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an opportunity to contribute to this activity. Then, assemble a methane generator according to the specifications, and observe the process as biogas is generated from animal waste. Project summaries should be submitted by each team and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

Caution: The use of glass laboratory equipment carries with it the risk of breakage and possible injury from broken glass. In addition, this task involves the production of methane gas, a highly flammable and explosive substance when concentrated properly. Under no circumstance is the methane generated in this experiment to be flared without the use of a bunsen burner or other similar device. Flaring gas directly from a container can result in the flame being drawn back into the gas container—resulting in an explosion.

A. Equipment and materials

- Safety glasses
- Three (3) 2 liter Erlenmeyer flasks (or equivalent)
- Three (3) rubber stoppers capable of being fitted with glass or Tygon tubing and dial thermometer

Job Sheet 2A

- Glass or Tygon tubing sufficient to plumb flasks according to illustrations
- One (1) gas-tight valve fitted to glass or Tygon tubing
- One (1) bunsen burner or similar device
- 1.5 liters of animal manure/water slurry
- Sufficient water to fill flasks 2 and 3 according to illustrations
- One (1) heat lamp
- One (1) dial thermometer
- One (1) aquarium pump (or other source of very low pressure air)

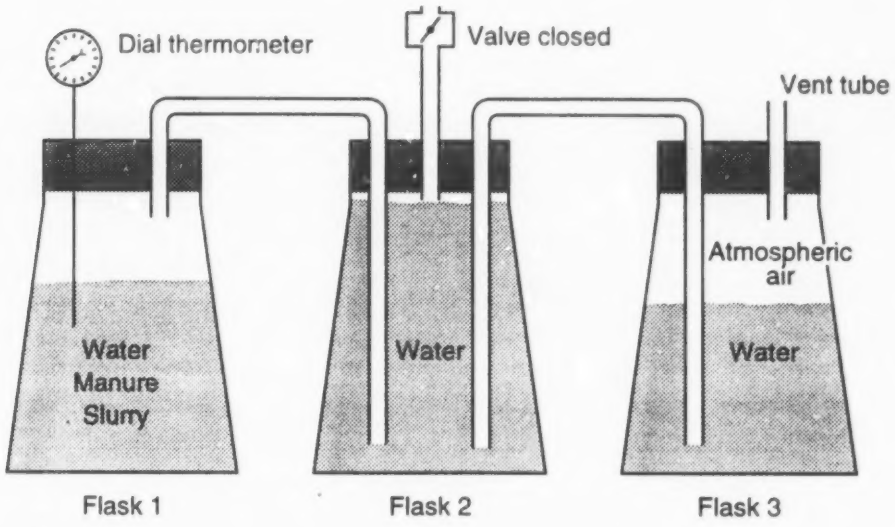
B. Procedure

Note: Read all directions before assembling anything in this experiment. Knowledge of the entire process will help you avoid accidents and better produce a useable quantity of methane gas.

☐ 1. Gather equipment and materials and put on safety glasses.

☐ 2. Assemble flasks, stoppers, tubing, valve and thermometer as shown in Figure 1.

Figure 1



☐ 3. Remove stoppers from flasks, install slurry material in Flask 1, and appropriate amounts of water in Flasks 2 and 3.

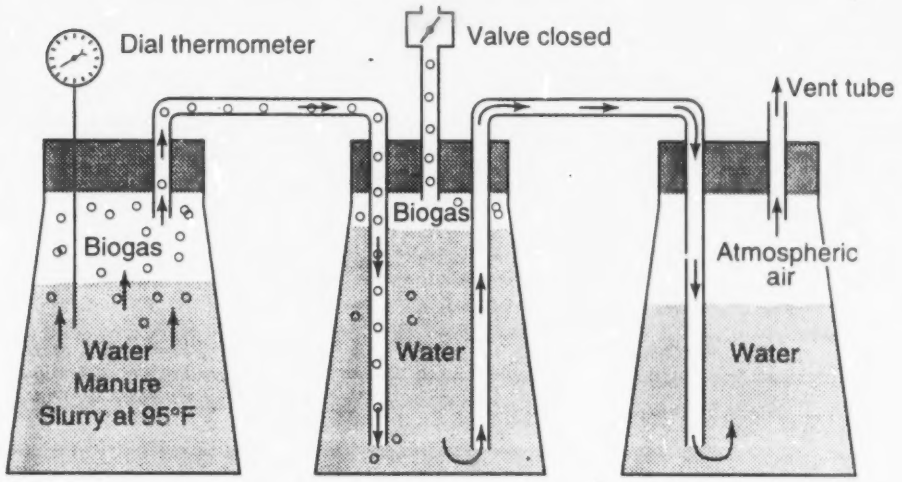
Caution: Animal manure contains bacteria and other pathogens which could be harmful to your health if ingested. Be certain to handle the material carefully and thoroughly wash your hands after completing the installation process.

Job Sheet 2A

☐ 4. Reinstall stoppers, being certain all fittings except the vent tube are air tight and valve is closed.

☐ 5. Position heat lamp near Flask 1 to maintain a 95° Fahrenheit slurry temperature. Remove safety glasses. See Figure 2.

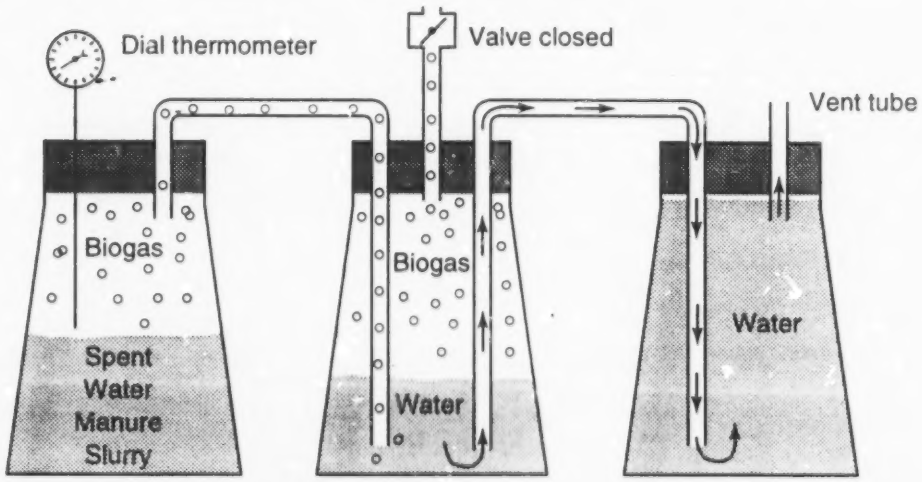
Figure 2



☐ 6. Observe the apparatus over a period of days to note the displacement of water from Flask 2 into Flask 3 as biogas is generated from slurry.

☐ 7. Once the water level in Flask 3 is approaching or entering the vent tube, remove heat lamp from Flask 1 and prepare to tap biogas as a fuel. See Figure 3.

Figure 3

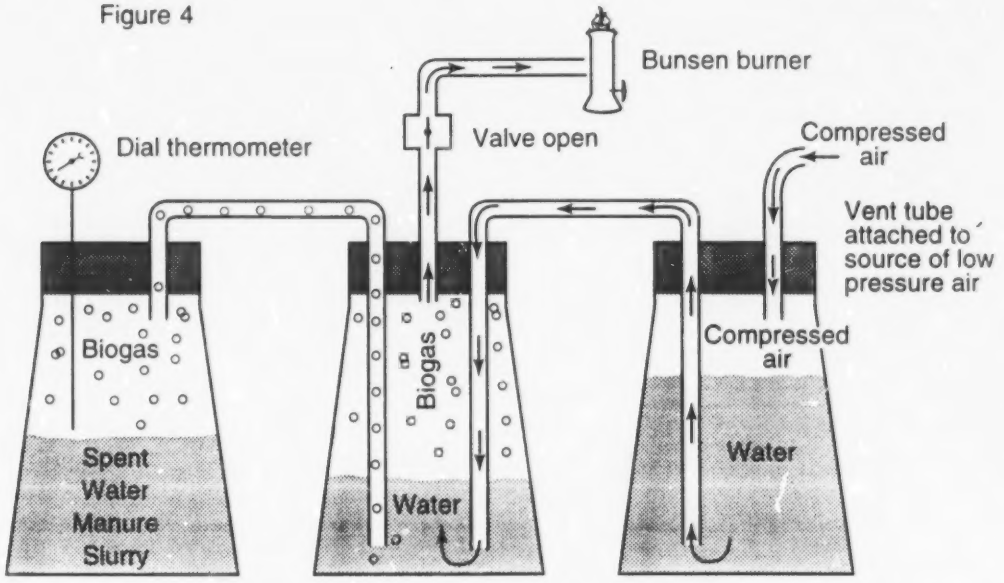


Job Sheet 2A

Note: Remember you will be dealing with a potentially explosive gas. Wear safety glasses at all times during the remainder of the experiment.

☐ 8. Attach aquarium pump (or other very low pressure air source) to the vent tube. Attach necessary fittings to Flask 2's valve to connect bunsen burner. See Figure 4.

Figure 4



☐ 9. At the same time you apply low pressure air to the vent tube by turning on the aquarium pump, begin to open the valve from Flask 2, allowing biogas to move into the bunsen burner.

☐ 10. Light bunsen burner and observe the use of methane you have produced from animal waste. Once flame disappears, disconnect the aquarium pump and disassemble the entire apparatus for cleaning.

Note: Dispose of spent slurry mixture in a sanitary toilet or a compost pile.

☐ 11. Prepare a two-page summary of the project (as a team), including the following:

- Any problems you encountered in constructing and/or operating methane generator
- What was observed throughout transformation process
- Estimated quantity of gas produced
- How methane gas might be used as an alternative energy source

Evaluator's comments: _____

_____

_____

_____

Forestry
Advanced Applications
Unit 7

Assignment Sheet 1A—Project Economic Returns From a Forestry Plot

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Report is well-documented and thorough in its grasp of the concepts	_____
• Report is well-written, neat, and legible	_____
• Assignment was completed on time	_____

Introduction: In most communities there are growers who have invested in long-term crops such as Christmas tree plots and/or firewood plantings. In some cases growers have planted extremely long-term crops such as walnut or pine timber plots. For instance, Christmas tree growers invest 7-10 years of time, expense, and labor before they begin to reap any returns from their management. A grower who plants black locust trees for firewood must wait about five years before beginning to harvest—although cutting black locust spurs new "sucker growth" which will again become firewood in another 6-8 years. Still, there is time, effort, and expense involved in a long-term enterprise such as forestry.

Directions: Working with your county's land-grant university agricultural agent, a representative of your state's forestry service, or a member of a federal forestry agency, seek out local "free farmers," arrange for a visit of their operation to become familiar with the investment necessary, and the profit potential from a long-term forestry crop.

Once you have discussed the operation, taken notes, and visited with the grower and related professionals, write a report detailing your findings and opinion as to why you would or would not enter into a similar operation if you had the necessary land and capital.

Forestry
Advanced Applications
Unit 7

Assignment Sheet 2A—Analyze Areas of Conflict in Maintaining Forests and Urban Trees

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Responses are logical	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Introduction: Forests, forest management practices, and the presence of trees affect everyone. In this exercise you will be asked to explain your reactions to various instances in which decisions about timbered land affect others.

Directions: Read the following scenarios, consider the various "sides" involved and why they do or think what they do, and in your own words respond with your reaction to the situation and what should be done to alleviate the conflict generated in each.

1. Since the time you were small, you and your family have enjoyed primitive camping on a high bluff overlooking a meandering mountain stream in a national forest managed by the U.S. Forest Service. Your photo albums are filled with pictures of activities at this camp site; you claimed a favorite pine tree nearby and charted your growth each year by secretly cutting a notch in its scaly bark each summer; the sound of the wind howling up the creek's canyon through the pine needles eases you to sleep at night even when you're miles away—remembering. It has been a place you have lived, laughed, and grown. Now, your favorite campsite is posted with "No Trespassing" signs and it is only a blackened landscape. It has been charred by fire allowed to burn by the Forest Service under a management plan that refuses to fight fires on FS lands unless they threaten lives or nearby private property. The Forest Service cites studies showing fire is necessary to maintain the vigor of a forest, to regenerate its diversity, and to provide "edge" habitat for wildlife.

   What is your reaction? _____

   _____

   _____

   _____

   _____

Assignment Sheet 2A

2. On a trip to the Rocky Mountains, you and your family drive across miles of Oklahoma, Kansas, and Colorado in June. As you pass through the flat, fertile wheat land of the Southern Plains you watch in wonder as farmers cut thousands of acres of ripened wheat. From fence row to fence row, the giant combines harvest the grain, leaving a dull yellow stubble and a cloud of chaff in their path. As you climb the foothills of the Rockies, you notice many more trees along the road and you see TePee-like metal structures on the outskirts of small towns—TePees with smoke rolling out of their domed tops. You realize these are waste incinerators at small sawmills where hundreds of logs are processed each day into lumber. Further into the mountains, you see a ragged clearing in the timber ahead, and realize a crew of loggers and large tractor-like machines are cutting trees and loading them on large semi-trailer trucks. They have cut an area as large as three football fields, and are continuing to cut every tree standing as they move across the forest floor. The scene looks like a giant wind storm has flattened everything in their area.

   What is your reaction? How is the clear-cutting logging operation any different than farmers cutting every stalk of wheat on a 600-acre wheat field? _____

   _____

   _____

   _____

   _____

3. You have finally made enough money to purchase your dream home. It sits about 100 feet back from the north-south road, facing west and shaded in the afternoon by gigantic silver maple trees growing along the edge of the property at the road's edge. The huge trees were one of the reasons you "fell in love" with the house. Shade from those trees help you keep your air conditioner bills low by reducing the heat load on the house during summer afternoons. You enjoy the many birds that fly in and out of the trees throughout the year. Then, one Monday morning you realize the local utility company has a crew of workers "topping" your favorite row of silver maples. Using chainsaws and hydraulic lifts they are systematically cutting the upper limbs out of the trees to allow 10 feet of clearance to the electrical power lines that run parallel with the road. The work is leaving giant holes in the trees, ruining their symmetry and promising to allow much of the afternoon sun directly onto your house. You storm out of the house and confront the work crews, only to be told the utility company has an easement on the property and can legally do anything it wants to the trees.

   What is your reaction? _____

   _____

   _____

   _____

   _____

Assignment Sheet 2A

4. You are a rancher whose livelihood depends upon the health of the grass pastures you manage for your cow herd. A scientifically-based practice of annual pasture burning helps you keep native prairie grasses vigorous and free of weeds and intercedi·g stands of grass-shading cedar trees and shinnery shrubs. Also, you have learned the pastures which have been burned in the spring produce better forage for cattle throughout the year—adding profitable pounds to your calves as you sell them in the fall. Your burning management mimics the "wild fires" that once swept across the prairie grasses as a result of lightning strikes, etc.—long before the land was settled and farmed and before fires were automatically termed the enemy. You have watched the weather conditions and found a nearly windless day with cool temperatures and high humidity readings—a perfect day for a controlled burn. You and your workers have planned the burn and are busy lighting fires and precautionary back fires when you see a line of cars and vans (including a TV news crew from a station about 100 miles away in the nearest larger city) pull up to your pasture. Those in the cars get out, jump your fence, and begin fighting the fire with wet sacks and backpack fire extinguishers. Some carry protest signs calling you an air polluter and a pyromaniac. The cameras are rolling and you are very aware someone may be hurt accidentally on your property, fighting the fire you are trying to control.

   What is your reaction? _____

5. As a developer of real estate, you have a 40-acre plot of wooded land you wish to subdivide and sell as homesites. As you plan how best to design your subdivision, you realize that by dozing out all of the timber on the plot and selling it for firewood, you could finance much of your land preparation expenses. In addition, without having to plan around stands of trees you could have the land sold and developed much more quickly than if you surveyed the lots in shapes to allow trees to stand. Economically, dozing the trees is the best deal to you.

   What is your reaction and what would you do? _____

Forestry
Advanced Applications
Unit 7

Assignment Sheet 3A—Analyze Current Reports Concerning Areas of Conflict in Forestry

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____
• Assignment was completed on time	_____

Introduction: Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to forestry.

Directions: Using books, magazines, and newspapers from your local or school library, and articles found in on-line computer services, clip and save at least five articles dealing with forestry and the controversies surrounding it. Examples of issues to explore would be: clear cutting vs. selective cutting; the 1988 Yellowstone Fire and various opinions on when and where forest fires should be fought, and if they should be fought; monoculture forests vs. varicultures; the use of controlled or prescribed burning to maintain a vigorous forest culture; the federal government's role in forest management.

In all cases there will be emotional stands taken on many sides. Using the information you have collected, consider the sides of the controversy and, in your own words explain to the class what the controversy is and what actions might be taken to solve it.

Note: For help in finding recent periodicals concerning controversies surrounding forestry, consult the *Reader's Guide* in your school or community library.

Wildlife Management
Advanced Applications
Unit 8

Assignment Sheet 1A—Investigate Game Animals, Hunting Seasons, and Bag Limits in Your Area

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• List is complete and well documented	_____
• Assignment was completed on time	_____

Introduction: Federal and state legislation was enacted to protect wildlife species from extinction and to provide for wildlife management. Established hunting seasons and bag limits help control wildlife populations by limiting the number of a particular species that can be killed by hunters each season.

Directions: Using information obtained from your state's wildlife department (See Student Supplement 1 in this unit), list the game animals, including fish and birds, in your state, list the season in which hunting is allowed for each, and list the bag limit for each. Record information on the form provided on the next page.

Assignment Sheet 1A

Game Animal	Hunting Season (From/To)	Bag Limit

Wildlife Management
Advanced Applications
Unit 8

Assignment Sheet 2A—Develop a Wildlife Food Plot

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Assignment was completed on time	_____

Introduction: One way to support wildlife is to ensure that food is available for the various species that inhabit areas in and around your community. By studying a species you can learn about their natural food sources and ways to improve food availability.

Directions: Select a game or non-game animal in your local area and determine its habitat and nutritional needs. From information obtained through your state's wildlife department, or through interviews with your local game ranger, develop a wildlife food plot for your selected animal. Obtain seed or seedlings from sources suggested by your state's land-grant university Cooperative Extension Center and plant them at the proper time to ensure survival. Observe the plot over time to determine if your food plot is actually attracting members of the species you chose.

Wildlife Management
Advanced Applications
Unit 8

Assignment Sheet 3A—Develop a Wildlife Habitat

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Assignment was completed on time	_____

Introduction: Through commercial development and agricultural practices the natural food sources and habitats of many species are destroyed. Without food and shelter a wildlife species may be depleted. In this assignment you will learn how to improve the habitat for a wildlife species.

Directions: Select a game or non-game animal in your local area and determine its habitat and nutritional needs. From information obtained through your state's wildlife department, or through interviews with your local game ranger, develop a plan to improve habitat potential (bird houses, nesting facilities, evergreen tree cover, artificial reefs for fish, etc.) for your selected animal. Obtain plans for any construction needed in the case of bird houses or nesting boxes. Obtain seed or seedlings from sources suggested by your state's land-grant university Cooperative Extension Center for wildlife habitat improvement. Using professional information concerning placement and design of wildlife habitat improvements for your selected species, plant or install the necessary additions in an area suitable for your species to live. Over time watch the area to determine if you have truly improved the habitat availability for your selected species. Write a two to three page report detailing the entire project from its inception to its overall success.

Wildlife Management
Advanced Applications
Unit 8

Assignment Sheet 4A—Make Management Decisions Concerning a Deer Herd

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Assignment was completed on time	_____

Introduction: What to wear, what to eat, and what to watch on television are examples of decisions that most of us make daily. Many decisions will take more effort than those we deal with on a daily basis, and some decisions will be made based on our own personal beliefs and experiences. Perhaps the most important skill we learn and develop is the ability to evaluate and choose the best alternatives for a given situation (decision making).

Directions: In this activity you will be asked to design a one-year plan for an expanding deer herd. You will determine your own individual plan and then, in conjunction with a team of classmates you will formulate a group plan. In both cases, you will be asked to explain to the class why you made the decisions you did. There is no one "right" answer in this exercise. But your answers will reflect your own beliefs and budgetary outlook.

You are the manager of a wildlife refuge. There is a herd of 200 deer on the refuge. This herd will expand at the rate of 200 deer per year. The refuge can support only 200 deer. Since the carrying capacity has been reached, the rates of disease and starvation are increasing. Farms surround the area and more deer are beginning to forage on these private lands in search of food.

Listed below are several ways to control the deer population. There is only $100,000 available to spend on this project, however. Devise a plan to manage the 200 surplus deer over the next year. Choose options, add the total costs, and stay within the $100,000 budget.

Option A. You can buy a plot of land adjoining the refuge for $50,000 that will support 50 deer.

Option B: You can improve habitat by planting shrubs to provide food and cover. For $50,000, you can accommodate 100 deer; $80,000 will provide for 120 deer; and $90,000 will provide for 130. Beyond this amount additional moneys for habitat does not add a significant number of deer.

Option C: You can hire professional game handlers to trap and relocate deer at a cost of $600 per deer.

Option D: You can hire professional hunters to remove the deer at a cost of $150 per deer.

Option E: You can purchase corn to supplement the deer's natural browse, at a cost of $300 per deer.

Assignment Sheet 4A

Option F: You can open the refuge to recreational hunting to licensed hunters who will remove the surplus deer. The cost of hunter education and law enforcement is $20,000 per year, or $100 per deer.

Use the following four grids to determine your deer management plan. Choose options from the list above and write the letter of the options chosen in the space provided. For example, if you pick Option A, "Expand Habitat" write "A" in the top blank space of the left column. Fill in the other blanks of the grids with the amount of money for that option and number of deer managed by that option. When you have finished listing your options (and you do not have to pick five, but can use one or two or as many as you like), total the columns to see how much of the budget has been used and if you have managed the necessary number of deer. The first two grids are for practice. Use the third grid to develop your individual plan and the fourth for your group's plan.

Practice Grid #1

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option #_____		
Option #_____		
Option #_____		
Option #_____		
Option #_____		
TOTALS:	$	

Practice Grid #2

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option #_____		
Option #_____		
Option #_____		
Option #_____		
Option #_____		
TOTALS:	$	

Grid #3 (Your Plan)

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option #_____		
Option #_____		
Option #_____		
Option #_____		
Option #_____		
TOTALS:	$	

Grid #4 (Group Plan)

Option(s) Chosen	Amount of Budget Used	Number of Deer Managed
Option #_____		
Option #_____		
Option #_____		
Option #_____		
Option #_____		
TOTALS:	$	

Wildlife Management
Advanced Applications
Unit 8

Assignment Sheet 5A—Analyze Current Reports Concerning Wildlife Management

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____

Introduction: Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching a topic relevant to wildlife management.

Directions: Using books and magazines from your local or school library, and articles found in on-line computer services, collect a minimum of five current articles (within the past two years) dealing with the U.S. Fish & Wildlife Service's $6.5 million project of reintroducing the wolf to the mountains of the United States. Based on the material you find, write a report outlining the reason why the U.S. Fish & Wildlife Service wants to reintroduce the wolf to the mountain states, and the resistance landowners in those states have shown. At the end of your report, draw your own conclusions about how to resolve this dilemma.

There have been suggestions—although they are rooted in the pitched emotions of the battle between Mountain state ranchers and the USF&WS—that if the wolf is to be reintroduced into the ranch country of the West, Congress should also mandate the Eastern Timberwolf be reintroduced into Central Park in the middle of New York City. What is your reaction to this? Why?

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning the USF&WS's plan to introduce the wolf to the mountain states, consult the *Reader's Guide* in your school or community library.

Wildlife Habitats
Advanced Applications
Unit 9

Student Supplement 1A—List of Wildlife Foods

Wildlife	Foods
Bass:	Fish, frogs and salamanders, turtles, snakes, crayfish, insects, earthworms, small mammals, spiders.
Bats:	Insects.
Beaver:	Bark, twigs and leaves, forbs (greens), aquatic plants (roots).
Bluebirds:	Seeds, fruit, insects.
Bluegill:	Insects, earthworms, spiders.
Butterflies:	Nectar from flowers.
Deer:	Tender leaves and twigs, buds, nuts, lichens, ferns, forbs (greens), fruit, mushrooms, grain, grass, bark.
Doves:	Grain, seeds.
Ducks:	Nuts, grain, insects, seeds, aquatic plants (seeds, leaves, bulbs, and tubers), snails, crayfish, frogs, salamanders, earthworms, fish.
Foxes:	Insects, deer carrion, birds, fruit, small mammals (rats, mice, and rabbits).
Frogs:	Insects, earthworms, spiders, crayfish, snails, other frogs, turtles, snakes.
Grouse:	Leaves and twigs, buds, insects, seeds, forbs (greens).
Hawks:	Insects, frogs and salamanders, snakes, lizards, birds, crayfish, small mammals (rats, mice, rabbits, squirrels).
Lizards:	Insects, spiders, other lizards, snakes, scorpions, birds, eggs, snails, small mammals (mice).
Marten:	Small mammals, birds, insects, fruit, frogs, fish.
Mink:	Small mammals, birds, fish, crayfish, insects.
Moles:	Insects, earthworms, snails.
Otter:	Fish, crayfish, birds, frogs, salamanders, mussels, small mammals.
Owls:	Birds, insects, snakes, small mammals (mice, rats, rabbits, shrews, miles, opossums, foxes).
Pronghorn:	Leaves and twigs, buds, forbs (greens), grass, grain, seeds.
Quail:	Forbs (greens), fruit, grain, insects, seeds, nuts, spiders.
Rabbits:	Forbs (greens), fruit, bark, grain, buds, grass, leaves and twigs.
Thrashers:	Seeds, insects, spiders, fruit.
Trout:	Insects, snails, crayfish, small fish, earthworms, spiders.
Turkeys:	Nuts, tubers, forbs (greens), seeds, insects, fruit, snails, centipedes and millipedes, grain, spiders, buds, grass.
Turtles:	Aquatic plants, fruit, mussels, forbs (greens), fish, crayfish, insects, spiders, carrion.
Wapiti (Elk):	Grass, leaves and twigs, buds, forbs (greens), bark, mushrooms.

Student Supplement 1A

Wildlife	Foods
Warblers:	Insects, spiders.
Woodpeckers:	Insects, fruit, spiders, lizards, seeds, grain, frogs, nuts.
Wrens:	Spiders, insects.
Salamanders:	Earthworms, snails, insects, centipedes.
Shrews:	Insects, snails, earthworms, salamanders.
Snakes:	Insects, birds, eggs, other snakes, fish, frogs, earthworms, small mammals (mice, rats), turtles.
Sparrows:	Insects, seeds, spiders, forbs (greens), buds, fruit.
Squirrels:	Nuts, seeds, buds, mushrooms, fruit, grain.

Wildlife Habitats
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Unit 9

Assignment Sheet 1A—Survey Non-Game Birds at a Feeding Station

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Report shows cognitive grasp of material	_____
• Report is well-written, neat, and legible	_____
• Assignment was completed on time	_____

Introduction: Numerous song birds and other non-game birds are found in abundance in many urban, suburban, and rural areas. A sampling of these species can be taken by observing an established bird-feeding station in early morning and late afternoon hours during cold winter weather—especially if there is snow cover or an approaching storm. Learning to identify such birds is relatively easy using various state wildlife agency identification guides or consulting with *The Audubon Society Field Guide to North American Birds* (Western and/or Eastern Region editions). This assignment will give you the opportunity to learn what non-game bird species are prevalent in your area and a chance to learn more about their habitat.

Directions: Station yourself at an established bird feeder filled with a bird feed mix of various seeds for two consecutive days at the same time (either early morning or early evening) for at least one hour. Using an appropriate bird identification guide, record the various species visiting the feeder and record the largest number of each species you observe at any one time on or near the feeder.

Once you have compiled your list, consult with the appropriate identification guide, or the Audubon guide mentioned above, to determine what habitat each of the recorded species require and what their native range is.

Based on your findings, write a report detailing your observations at the bird feeder. Include examples of nearby habitat for each species (i.e., cedar trees for Cardinals, open areas with fruit and seed for bluebirds, etc.). And, make suggestions based on your observations of the area near the bird feeder for improving habitat for the species you observed.

Assignment Sheet 1A

Bird Feeding Station Observation Log

Date: _____ Time observed: From _____ To _____

Date: _____ Time observed: From _____ To _____

Location of bird feeder: _____

Specie	Largest number seen at one time

Wildlife Habitats
Advanced Applications
Unit 9

Assignment Sheet 2A—Survey Wildlife Foods

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Report shows cognitive grasp of material	_____
• Report is well-written, neat, and legible	_____
• Assignment was completed on time	_____

Introduction: All areas, rural, suburban, and urban provide some food suitable for wildlife. Some, of course provide a wider variety of food for many species than others, but even in the middle of the most developed urban area there are food sources for some species of wildlife. In this exercise, you will be asked to survey an area (assigned by your instructor) for the various wildlife foods available.

Directions: Using the list of wildlife foods found in Student Supplement 1A, search your assigned area and note the presence of each and its relative abundance. Once you have thoroughly evaluated your assigned area and compiled a list of the foods available, make a list of possible wildlife species that could be present in your assigned area. If there are obvious reasons why some species might not be found in your area even if potential food is available, (i.e., deer more than likely would not be found in the middle of an urban area even if a local park provided food suitable for deer), note reasons why you think they are not present.

Select two species from the list of wildlife in Student Supplement 1A and write a report on your suggestions for improving and providing additional food sources in your assigned area for these species. Turn in your list and written report to the instructor.

Wildlife Habitats
Advanced Applications
Unit 9

Assignment Sheet 3A—Survey for Wildlife Signs

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Report shows cognitive grasp of material	_____
• Report is well-written, neat, and legible	_____
• Assignment was completed on time	_____

Introduction: Wildlife leave signs of their presence in the form of tracks, droppings, damage (in the case of woodpeckers or rats and mice), rubs, nests, burrows, and evidence of kills (in the case of predators). This assignment will allow you to sharpen your skills at surveying an area to find signs of various wildlife present.

Directions: After consulting with wildlife conservation officials or wildlife biologists who have visited in your class, and using field guides to wildlife tracks and signs from your state wildlife conservation department or land-grant university, survey your assigned area (assigned or agreed upon by your instructor) for the evidence of wildlife presence.

Write a report detailing your findings and listing the various species of wildlife for which you found evidence in your search. Turn in your report to your instructor.

Wildlife Habitats
Advanced Applications
Unit 9

Assignment Sheet 4A—Develop a Management Plan for a Farm Pond for Sport Fishing

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student displayed serious effort at project and its goals	_____
• Report and drawings evidence cognitive grasp of information needed for farm pond management.	_____
• Report is well-written, neat, and legible	_____
• Assignment was completed on time	_____

Introduction: Many farms and suburban homes are located near ponds built for livestock watering or upstream flood control. In many cases, these bodies of water have not been managed for any particular purpose, therefore, they do not contain significant populations of game fish. In addition, many are not accessible for those who might want to fish. This exercise can be accomplished by an individual or as a class project with the help of wildlife biologists or land-grant university aquatic specialists and literature from various state agencies concerned with sport fisheries.

Directions: Using a pond selected by you or your instructor, determine a game fish you wish to cultivate for sport fishing in that pond. Study the habitat needed for that fish, and evaluate the pond for its ability to provide that habitat. Make recommendations on what actions are needed to improve the game fish habitat of the pond selected. Use the following list of questions to work your way through a comprehensive management plan for your selected pond. Once you have studied and answered the following questions, write a report describing the current condition of the pond, what habitat it provides and what needs to be done to improve its habitat for the game fish you selected. Also, detail with drawings and maps what construction or other management activities you would accomplish in your quest to make this pond an attractive sport fishing body of water.

Pond Management Survey

1. What are the overall dimensions of the pond?

   Length _____ Width _____

   Depth _____ Acreage of surface area and volume _____

Assignment Sheet 4A

2. What is the current use of the pond?

3. Describe the land surrounding the pond and how it affects the pond's water supply and clarity. (Is there silt runoff? What is the watershed of the pond? Is there livestock grazing allowed on pond banks? Are there open gullies feeding the pond? Does the pond catch runoff water from grassed pastures?)

4. What are the predominant fish species found in the pond?

5. Is there an abundance of water and snapping turtles in the pond?

6. Describe the depth of the pond's water near the shoreline. (Shallow banks gradually sloping into deeper water, which allows for aquatic vegetation, or steep drop offs into deeper water).

7. Does the pond's water level show evidence of stability or are there wide annual fluctuations?

Assignment Sheet 4A

8. What cover and shelter for fish is there in the pond, and where is it located?

9. What shoreline vegetation is available, and what food sources are there for game fish?

10. Are there roads or access paths to the pond? Would the pond require a float tube or boat to fish it?

11. What are your state's regulations concerning pond renovation before state-sponsored fish can be stocked in a private pond?

12. What other species of wildlife are evident in abundance on, in, or near the pond?

13. What types of artificial cover could you install in the pond to provide nesting and resting areas for game fish and their prey? (Many communities use old tires, Christmas trees, pallets, sunken plastic drums, etc. as artificial reefs and nesting areas in public fishing areas.)

Wildlife Habitats
Advanced Applications
Unit 8

Assignment Sheet 5A—Analyze Current Reports Concerning Wildlife Habitats

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Minimum of five current articles collected	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____
• Assignment was completed on time	_____

Introduction: Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to wildlife habitats.

Directions: Using books, magazines, and newspapers from your local or school library, and articles found in on-line computer services, clip and save at least five articles dealing with public controversy over wildlife habitats and competing uses of the land in question. Try to find articles representing the various interest groups involved in the controversy.

After reading the articles, write a report detailing the controversy as it has been reported and write a description of how you would attempt to solve the controversy if you were assigned that duty. In your solution, try to accommodate the various interest groups involved.

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning the public controversy over wildlife habitats and land use, consult the *Reader's Guide* in your school or community library.

Wildlife Habitats
Advanced Applications
Unit 9

Job Sheet 1A—Construct Nesting Sites

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student actively took part in project	_____
• Nesting facilities built and distributed	_____
• Nesting sites observed/photographed	_____
• Worked cooperatively with others to reach a common goal	_____
• Project summary was thorough and well written	_____

Introduction: Throughout North America a number of birds, fish, and mammals require nesting sites that have become scarce because of development, timber clearing, or other destruction of habitat. Some of these include the wood duck, bluebird, various bats, pond fish, etc. This assignment will allow you to study a given member of the wildlife population in your area, and build and distribute nesting facilities for that species.

Directions: Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an equal opportunity to contribute to this activity. Construct nesting sites for your chosen species. Then, as a class, distribute the completed nesting facilities in and around your community. Each team must select one of the project sites and observe how the nesting facilities are being used as part of the wildlife habitat. Project summaries should be submitted by each team and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

A. Equipment and materials

- Plans or kits for nesting facilities
- Materials as specified on plans
- Basic tool kit
- Camera, flash attachment, and film

B. Procedure

☐ 1. Consult with wildlife conservation officials or wildlife biologists in your state to determine a species that may be aided by increased numbers of nesting sites.

☐ 2. Obtain plans or kits for such nesting or resting facilities and build a number of these (according to plans) to be distributed in your area.

Job Sheet 1A

☐ 3. Distribute the nesting and/or resting facilities in areas most likely to attract increased numbers of your chosen species.

☐ 4. Observe the nesting sites and photograph the occupants that take up residence in your provided habitat.

☐ 5. Prepare a two-page summary of the project (as a team), including the following:

- Name of chosen species
- Reason why particular species selected
- Type of nesting/resting facility constructed
- Locations of nesting sites
- Photographs of species that reside in nesting facility
- Benefits of project to wildlife habitat improvement

Evaluator's comments: _____

_____

_____

_____

Wildlife Habitats
Advanced Applications
Unit 9

Job Sheet 2A—Increase Hummingbird Habitat

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Student actively took part in project	_____
• Appropriate flower species planted	_____
• Hummingbird feeders obtained and distributed	_____
• Hummingbirds observed/photographed	_____
• Worked cooperatively with others to reach a common goal	_____
• Project summary was thorough and well written	_____

Introduction: With 15 species of hummingbirds common to many areas of North America, this non-game bird is relatively easy to attract—sometimes in large numbers. This assignment will allow you to improve hummingbird habitat and study the needs of this tiny, colorful bird.

Directions: Before beginning this activity, your instructor will divide the class into teams of 3-4 students. As a team, assign specific tasks to each team member so that everyone has an equal opportunity to contribute to this activity. Project summaries should be submitted by each team and team members should be prepared to discuss findings in class.

Your instructor will observe individual and group activities and rate your performance using the evaluation criteria.

A. Equipment and materials

- Flower species used by hummingbirds
- Garden tools
- Hummingbird feeders or materials to build feeders
- Basic tool kit
- Camera, flash attachment, and film

B. Procedure

☐ 1. Obtain information available from land-grant university wildlife biologists or state wildlife conservation personnel concerning the hummingbird and its habitat.

☐ 2. Study the nesting habits of the hummingbird, and make notes concerning their needs.

☐ 3. Purchase hummingbird feeders or obtain plans or kits to build the feeders.

☐ 4. Construct hummingbird feeders according to plans (if necessary).

Job Sheet 2A

☐ 5. Install the hummingbird feeders in areas most likely to attract these tiny birds.

☐ 6. Observe the hummingbirds and photograph the birds during their visits to your flower "plantings" and hummingbird feeding stations.

☐ 7. Prepare a two-page summary of the project (as a team), including the following:

- Basic needs of the hummingbird
- Nesting habits of the hummingbird
- Flower species planted by team
- Locations of plantings and feeding stations
- Photographs of hummingbirds at plantings and/or feeder stations
- Benefits of project to hummingbird habitat improvement

Evaluator's comments: _____

_____

_____

_____

Outdoor Recreation
Advanced Applications
Unit 10

Student Supplement 1A—The Dakota Fire Hole

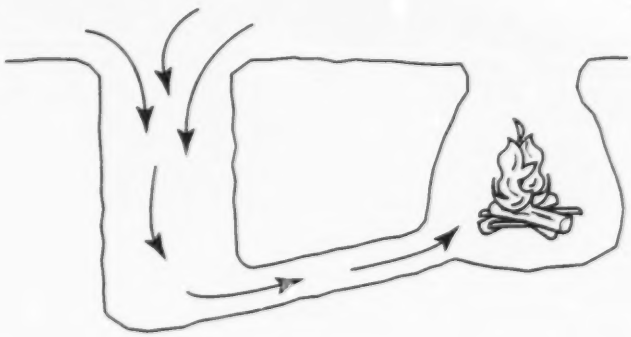
Although building bonfire-size camp fires is fun where they can be safely controlled, backpackers, day hikers, bicycle campers, and those in survival situations would be better served by a small, efficient fire that will not easily get out of control and requires little attention and only small amounts of fuel.

The Native Americans who roamed the vastness of the treeless Great Plains knew the value of such small fires and were adept at building fires in small holes where the heat from scarce firewood and animal dung could be concentrated. Somewhere, since those days of nomadic tribes of Plains Indians, the fire hole was redesigned and today it works even better. This refinement is called the Dakota Fire Hole.

To make one, you'll need a shovel and a knife. Start by digging the fire hole in the cooking area of your campsite—out of the way of foot traffic. Dig the circular hole 14 to 16 inches deep with straight sides. The diameter of your fire hole should be only slightly larger than the cooking utensils you plan to use. If the earth is mellow enough, use the knife to make the bottom of the hole "bell" shaped—to allow for a larger fuel supply.

About 12 to 18 inches away from the fire hole, dig the chimney hole. The walls of this hole are also vertical, but the hole itself should be 2 to 3 inches deeper than the fire hole.

With the two holes dug, tunnel from the bottom of the chimney hole to just above the bottom of the fire hole (a slight incline from the chimney hole to the fire hole)—taking care to make this tunnel as small in diameter as possible. By entering the side of the fire hole, the tunnel will not become clogged with coals that could stop the draft and extinguish the fire. The difference in depth in the two holes allows a better draft for a hotter fire, and allows drainage away from the first hole in case of rain.



Start a fire in the bottom of the fire hole, using very small amounts of wood, gradually adding larger pieces up to those about the size of your wrist in diameter. Develop a hot bed of coals in the hole—remembering you can only add fuel from the top of the hole.

Student Supplement 1A

Once the fire is ready, you can begin cooking by placing a grill directly on the ground over the fire hole. If the fire becomes too hot, simply put a ground cloth, your hat or coat over a portion of the chimney hole to restrict the air to the fire.

The Dakota Fire Hole also provides a good, concentrated heat source for heating water to clean cooking and eating utensils. Just set the water containers over the fire—making certain you don't cover the top of the fire hole completely, allowing proper drafting.

With your fire contained in the fire hole, winds are not likely to cause it to spread as you use it—even in grassland. Also, when it's time to leave camp, the dirt removed from the chimney and fire holes should be replaced—effectively burying the fire and any remaining coals so they will not cause fires after you move on down the trail.

Outdoor Recreation
Advanced Applications
Unit 10

Student Supplement 2A—Friends in the Night Sky

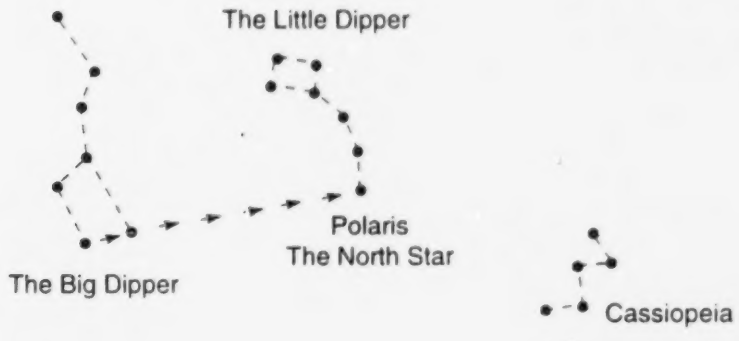
Throughout recorded history humans have been fascinated with the stars and other elements of the night sky such as comets, meteors, and the brilliant periodic cycles of Earth's neighboring planets.

A knowledge of the various star arrangements, called constellations, can be a comforting asset on lonely nights, particularly if one is lost or otherwise disoriented in the outdoors.

In the northern hemisphere (anything north of the Equator), all stars appear to revolve in concentric circles around a point called the *north celestial pole*—the heavenly counterpart to the Earth's north pole. For star gazers whose latitude is 40 degrees or more, there are a number of constellations within 40 degrees of the north celestial pole that never set; they belong to a region of the sky known as the *northern circumpolar zone.* The various star arrangements, named in ancient times include the dancing bears *Ursa Major* and *Ursa Minor*, their serpentine companion *Draco*, *Cephus* the king and *Cassiopeia* the queen, a giraffe named *Camelopardalus*, and the northern most part of *Lynx*, a constellation which, to some appears as a big cat's tail (a straight line)—the only part visible as the "cat bathes in the ocean." For outdoor activists this portion of the night time heavens is an important tool for direction finding.

Within the constellation *Ursa Major* is found the most famous starry "land mark," the Big Dipper. This familiar formation of 7 to 8 stars revolves around *Polaris*, the North Star, and serves as a ready directional guide to those at sea or throughout most of the northern hemisphere. If one can find the Big Dipper, then one can surely find Polaris (See Figure 1), a star which appears to remain stationary because it is located in the axis of the north celestial pole. As the Earth revolves, *Polaris* appears stationary—always a guide to true north. Using the two end stars of the bowl of the Big Dipper, one can draw an imaginary line upward (in relationship to the dipper's bowl) to a single somewhat dim but solitary star about halfway between the Big Dipper and *Cassiopeia—Polaris.* (*Polaris* is the end star in the handle of the Little Dipper *(Ursa Minor)*, another constellation shaped similarly to the Big Dipper but much more dim in appearance.

Figure 1



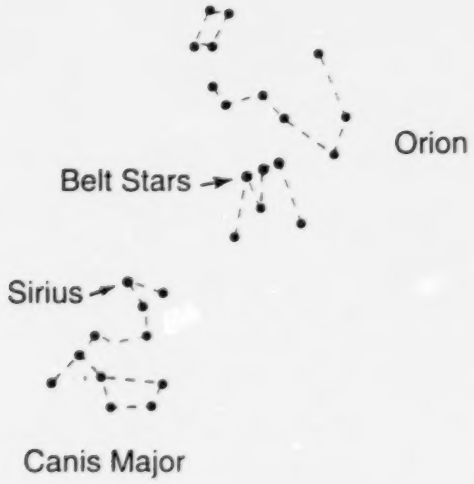
Student Supplement 2A

For those in the southern hemisphere, south of the Equator, a similar constellation, the Southern Cross, serves as a direction finder for those seeking a night time reference point.

Throughout the year, as the Earth orbits the sun on its tilted axis, different constellations not located in the northern circumpolar zone become visible to those in the northern hemisphere.

Some of the more famous include Orion the hunter, a striking arrangement of some of the brightest stars in the late fall and winter sky. Nearby *Orion* are two constellations that appeared to the ancients to be Orion's dogs, *Canis Major* (which includes Sirius, the brightest star in Earth's night sky) and *Canis Minor*. During autumn, *Sirius* hangs in the eastern and southeastern sky like a brightly lit jewel just before sunrise. *Orion* with his three bright "belt" stars has been quite visible through the early morning hours and is about to set as the sun comes up. (See Figure 2).

Figure 2



The study of the night sky is a fascinating part of outdoor recreation. Suggestions to learn more about the stars, the constellations, and how they obtained their sometimes strange names and characters, include visits to your school or public library. Also, bookstores stock many books on star gazing, along with "star charts" which can be adjusted to the month of the year to give you a view of what constellations are in view on what dates.

Outdoor Recreation
Advanced Applications
Unit 10

Assignment Sheet 1A—Develop a Historical Presentation for Visitors to Your Area

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Worked cooperatively with others to reach a common goal	_____
• Student displayed serious effort at project and its goal	_____
• Presentation was well-researched, informative, and interesting	_____
• Spoke in a clear, concise manner	_____
• Used appropriate eye contact, gestures, and posture	_____

Introduction: The history of any locale in the United States can be interesting and educational to people who are from another area. Many people who use recreational vehicles spend a day or two in private and public campgrounds before moving on and never have any idea of the historical significance of the town or area in which they are staying.

In this assignment you will be asked to work in a team to research local historical events and to develop a skit that can be presented to visitors to your area.

Directions: Before beginning this activity, your instructor will divide the class into groups to research local historical events and develop skits about those events.

Visit your local public libraries and museums and talk with members of local historical societies to determine interesting historical incidents that have happened in your town, county, or local interest area. (In areas where RV camps are located near natural attractions or historical sites, incidents which were related to those attractions would be of interest to tourists.)

From your studies of local records, old newspaper accounts, books on local history, and interviews with people who may have "lived" the history of your area, select one event and develop a 15- to 20-minute skit to recreate that event to present to groups of tourists. As a team, determine what responsibilities each member will have in developing and presenting the skit. All team members should be prepared to answer questions after your presentation.

Once your groups presentation is polished, meet with managers of local public and private RV campgrounds and seek their approval to schedule your presentation during evening hours in the playground or store area of their campgrounds. If no campground is available, schedule your presentation for students at your school or a local elementary school.

Outdoor Recreation
Advanced Applications
Unit 10

Assignment Sheet 2A—Evaluate Conflict Resolution Scenarios

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Answers show insight into human behavior and judgment of actions to take	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Introduction: As more and more people take advantage of the endless opportunities of recreation in the outdoors, more and more people of different outlooks, likes, and dislikes come in contact with one another. The result: conflicts arise. This assignment will acquaint you with some typical conflicts in various outdoor recreation scenarios.

Directions: Read each scenario, consider both sides of the conflict, and answer the question posed in each.

1. You are the caretaker and manager of a federal campground operated by the U.S. Army Corps of Engineers on a large flood control lake. In one of your campgrounds, the teenage son of a family has been left alone with the family's tent camper and is playing a stereo at full volume and practicing with martial arts weapons. When anyone approaches him or even stares in his direction, he assumes a belligerent, threatening, and aggressive stance. Several campers from nearby campsites have complained to you about this individual's behavior and are upset that their "peace and quiet" has been disturbed. You are not authorized to carry weapons and are not trained in hand-to-hand combat. You are an hourly-paid employee in charge of caring for and running the campground. Experience tells you it could be 30 minutes to an hour before Highway Patrol troopers or the county sheriff's department can respond, and the nearest Corps of Engineers enforcement people are 120 miles away. What do you do?

   _____

   _____

   _____

2. As the manager of a private, recreational vehicle campground it is your responsibility to assign various campers to the best possible sites available on a first-come, first-served basis, after accommodating campers who have made reservations. You have placed a family group of campers in a series of adjoining campsites to allow them close contact with one another and easy access to the public showers and restrooms. Shortly after they have established their

Assignment Sheet 2A

camping equipment and begun to relax, you are informed by an arriving camper the middle site you have assigned to the family has been reserved for her for three months. In addition, the reservation was guaranteed by a payment-in-full check in advance. She is tired from a 12-hour drive, it's too late to find other accommodations in the area, and she is furious her reservations have been ignored. Even after you offer what, to you is a better campsite, she is still seething and threatening to contact your franchise office—a move which could cause you significant financial problems. What do you do?

3. You are the operator of a canoe concession on a clear, meandering river that offers mild to wild canoe trips for the general public. Once your canoeists make their full-day or half-day trip, they arrive at a widening, quiet part of the river that is crossed by an old county road bridge. The bridge has been used for years by many fishermen who dangle their lines off the bridge into the quiet, deep waters below. Over the past several weeks a number of your clients have complained of anglers harassing canoeists as they glide beneath the bridge. In another instance, a group of youths which included the county sheriff's son, was involved in a bottle throwing incident in which bottles landed in the canoes as they passed under the bridge. Your business depends upon happy customers, and being hassled at the end of the day on a public river doesn't make their mood very positive. The riverbank's terrain and private property lines prevent you from taking canoes out upstream of the bridge. What do you do?

4. You are the manager of a 27,000-acre yellow-pine forest recently purchased by your employer, a multi-national wood products company. For years, the land you manage was owned by a local timber company that operated on what you think were outdated management practices that allowed open range cattle on the land and unrestricted access to hunters, anglers, and picnickers. Now, your firm has fenced the perimeter of the forest to prevent cattle from grazing its borders, and your management has instructed you to end unrestricted access to the land. Many of your forest's neighbors grew up hunting on this land, and many of them have run cattle on its hillsides for generations. Access to the land you manage has been taken for granted by the locals for longer than you have been alive. As you cruise the forest inventorying its timber stands you find evidence of deer poaching throughout all months of the year. Also, the fence your firm has built around the forest is regularly cut and unbranded cattle allowed to graze at will. You also have noticed a number of cases of arson in the forest coinciding with confrontations you and your staff have had with locals found on the land without permission. Although the people of the area are outwardly friendly there is a distinct air of lawlessness among them. You are viewed as an outsider. What do you do?

Assignment Sheet 2A

5. As the leader of a youth shelter for abused, neglected and sometimes law-breaking teenagers, you obtain permission from your city officials for your group to clean up an abandoned railroad depot to convert it to a youth recreation center. You plan to use the concrete parking lot as a basketball court, the lobby as a meeting room, and the sidewalks and baggage area for various games such as hop scotch and four-square courts. As you begin work days with your teenage crews it soon becomes apparent two homeowners adjacent to your property are not at all pleased with the presence of "troubled" youth in their neighborhood. They harangue you while you work, causing some of the young people to become belligerent in their own defense. This just adds to the conflict. You know the old depot could become a vital resource for the rehabilitation of your young people, and you know the neighbors have a legitimate concern about their property values and potential crime in the area. What do you do about the immediate problem of a confrontation between the neighbors and your youths? What do you do to defuse this situation before someone takes legal action or becomes violent?

Outdoor Recreation
Advanced Applications
Unit 10

Assignment Sheet 3A—Give Accurate, Easy-to-Follow Directions

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Directions have been followed	_____
• Assignment is neat and legible	_____
• Assignment was completed on time	_____

Introduction: All states and many cities are making an effort to increase tourism to import dollars into their economies. Given this influx of tourists to many areas, those people involved in outdoor recreation careers will many times be asked for directions to local facilities and attractions. This assignment will give you a chance to work on giving efficient, easy-to-follow directions. Remember, some people have no idea of directions on a compass (North, East, West, South), and only grasp "right" and "left," "forward" and "back."

Directions: Give short, easy-to-follow directions using the compass directions and distances such as city blocks, stop lights, section lines, landmarks, etc. from your school to the following places:

1. The nearest public library

_____

_____

_____

2. The nearest hospital emergency room

_____

_____

_____

3. A good place to fish

_____

_____

_____

Assignment Sheet 3A

4. A good place to eat barbecue

5. The county courthouse

Directions: Give short, easy-to-follow instructions using "right", "left", "at an angle", etc. and distances such as blocks, miles, stop lights, section lines, etc. from your school to the following places:

1. A lake on which one can water ski

2. A historical monument or marker

3. The quickest route leading to the nearest Interstate highway

4. A place for a quiet picnic

Assignment Sheet 3A

5. An airport

_____

_____

_____

Outdoor Recreation
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Unit 10

Assignment Sheet 4A—Locate Constellations in the Night Sky

Name _____ Overall Rating _____

Evaluation criterion	Rating
• Constellations located	_____

Introduction: In many forms of outdoor recreation being outside at night is required, or will be encountered. Knowing some of the more famous and easy-to-find constellations of stars in the night sky is enjoyable and can be very handy in determining directions at night.

Directions: Using information from Student Supplement 2A—Friends in the Night Sky, and star guides and basic astronomy books, point out the following "land marks" in the night sky. (Please note some of these constellations are more easily seen at different times of the year. Check with a "Star Chart" or reference book devoted to the various locations of constellations during the various months.)

1. Orion "The Hunter"
2. The Big Dipper
3. Cassiopeia (or Cassiopeia's Chair)
4. Pleiades
5. Pegasus "The Flying Horse"
6. Polaris "The North Star"
7. The Little Dipper
8. Triangulum
9. Sirius "The Dog Star"
10. Mars "The Red Planet"

Outdoor Recreation
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Unit 10

Assignment Sheet 5A—Analyze Current Reports Concerning the Growth of Outdoor Recreation and its Effects on the Environment

Name _____ Overall Rating _____

Evaluation criteria	Rating
• Minimum of five current articles collected	_____
• Directions have been followed	_____
• Content is relevant and well organized	_____
• Report is neat and legible	_____
• Report was completed on time	_____

Introduction: Throughout this study of natural resources, you will be asked to research and report on a variety of subjects according to material being covered in the specific units of instruction you are studying. In this assignment you will be researching material relevant to outdoor recreation.

Directions: Using books, magazines, and newspapers from your local or school library, and articles found in on-line computer services, clip and save at least five articles dealing with the growth of outdoor recreation and its effects upon the environment. In most, there will be at least two opposing viewpoints. Take one of the current event stories you have collected, consider both sides of the controversy and, in your own words, explain to the class what the controversy is and how a compromise might be worked out to somewhat satisfy both those involved in the outdoor recreation activity in question, and those who feel it is harming the environment. (Examples might be aircraft that fly over the Grand Canyon; the ever-increasing crowds in Yosemite and Yellowstone National Parks; or jet boats on the Columbia and Snake Rivers.)

Your instructor will provide you with guidelines explaining the format of the finished report. This assignment will be collected and retained in a portfolio that will become a record of the progress you have made in your study of natural resources.

Note: For help in finding recent periodicals concerning outdoor recreation and its effects on the environment, consult the *Reader's Guide* in your school or community library.

Outdoor Recreation
Advanced Applications
Unit 10

Job Sheet 1A—Build a Wood-Conserving Dakota Fire Hole

Name _____ Attempt Number _____

Date _____ Overall Rating _____

Evaluation criteria	Rating
• Holes and tunnel dug according to specifications	_____
• Fire built with small to medium sizes of wood	_____
• Fire thoroughly extinguished	_____
• Proper safety precautions observed in hole construction and fire building	_____

Introduction: When backpacking or camping in areas where little firewood is available, it is still comforting and convenient to have a fire for cooking and companionship. This assignment will provide you with an opportunity to construct a fire hole designed from those used by Native Americans who frequented the treeless Great Plains and had to conserve fuel by necessity.

Directions: When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

A. Equipment and materials

- Shovel
- Knife
- Firewood
- Matches or lighter
- Wire grill
- Ground cloth
- Water
- Cooking and eating utensils
- Food to prepare

B. Procedure

Note: Review the information concerning the fire triangle and fire safety in Unit 1 before proceeding with this activity.

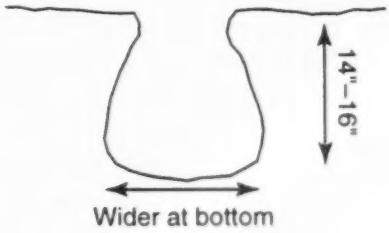
☐ 1. Select the cooking area for your campsite, away from foot traffic.

☐ 2. Dig a circular hole 14 to 16 inches deep and slightly wider than your cooking utensils. (See Figure 1.)

Job Sheet 1A

☐ 3. Use a knife to make the bottom of the hole "bell" shaped to provide additional space for the firewood. (See Figure 1.)

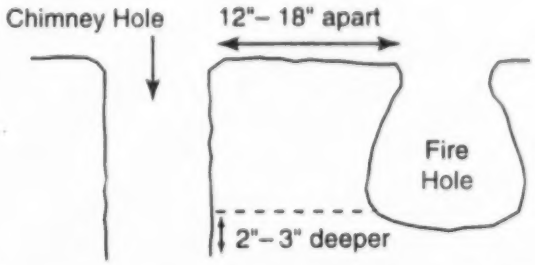
Figure 1



☐ 4. Dig the chimney hole approximately 12 to 18 inches away from the fire hole. This hole should be about the same width, but should be 2 to 3 inches deeper than the fire hole. (See Figure 2.)

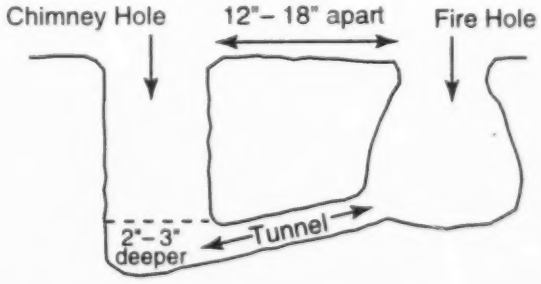
Note: This hole does not need to be "bell" shaped.

Figure 2



☐ 5. Dig a tunnel as small in diameter as possible leading from the bottom of the chimney hole to just above the bottom of the fire hole. (See Figure 3.)

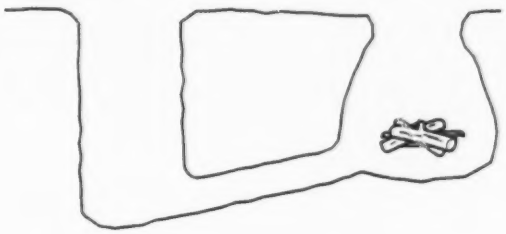
Figure 3



Job Sheet 1A

☐ 6. Place small amounts of firewood at the bottom of the fire hole. (See Figure 4.)

Figure 4



☐ 7. Ignite the firewood, gradually adding larger pieces of wood until a hot bed of coals has been created.

☐ 8. Place the wire grill directly on the ground over the fire hole.

☐ 9. Use a ground cloth, if needed, to cover the chimney hole to restrict air to the fire.

☐ 10. Place cooking utensils on grill and prepare food.

☐ 11. Clean cooking and eating utensils using water heated on grill.

☐ 12. Place dirt removed from chimney and fire holes back in the holes to extinguish fire.

☐ 13. Pick up campsite and check for any remaining equipment and materials.

Evaluator's comments: _____

_____

_____

_____

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